

CTSW-RT-02-021

CALTRANS PUBLIC EDUCATION LITTER MONITORING STUDY 2001–2002

REPORT
SEPTEMBER 2002



Prepared for:
**CALIFORNIA DEPARTMENT OF TRANSPORTATION
SACRAMENTO, CALIFORNIA**

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The Caltrans Public Education Litter Monitoring Study (PELMS) was initiated prior to the 2000-2001 rain season to collect storm water litter data at Caltrans highway sites in Fresno and Stockton, California. This report presents storm water litter monitoring results from the second season of monitoring (2001-2002). Data from the first season of monitoring is presented in the 2000-2001 monitoring report (CTSW-RT-01-018). The purpose of the PELMS is to provide data in support of the Caltrans Public Education Research Study (PERS). The objective of the PERS is to implement and assess a public education program targeted at reducing storm water litter pollutants. Public education media rollout for the PERS started in mid-February 2002. Storm water litter monitoring is one of several methods that will be used to gauge public education effectiveness. Other methods include public opinion surveys and an assessment of roadside litter collection before and after program implementation.

Litter in storm water is defined by Caltrans as manufactured items made from paper, plastic, cardboard, glass, metal, etc. that can be retained by 5-mm ($\frac{1}{4}$ inch) mesh. This definition does not include materials that are of natural origin (i.e. does not include sand, soil, gravel, vegetation, etc.). Samples collected during storm water litter monitoring are considered gross pollutants, which consist of co-mingled litter and vegetation.

Storm water litter monitoring was conducted at fourteen sites in Fresno and two sites on Interstate (I5) in Stockton. The fourteen Fresno sites consist of four sites on State Route (SR) 41, four sites on SR 180, four sites on SR 99, and two sites on Old SR 180. The Old SR 180 sites monitor runoff that enters curb inlets on a Caltrans surface street. The remaining fourteen sites monitor freeway runoff at fill-slope outfalls or standard taper entrances. All sites were monitored for the entire 2001-2002 rain season.

Litter monitoring was conducted by attaching 5-mm ($\frac{1}{4}$ -inch) mesh collection bags to study outfalls or curb inlet monitoring devices. Precipitation data was collected at two Fresno sites and near the Stockton sites. Flow data was collected at two Fresno sites where chemical water quality samples were also collected to provide data for the Caltrans Statewide Monitoring Program. Litter collection nets were in-place at all times once a monitoring site was installed. This allowed for the collection of samples resulting from incidental rain or nuisance flow for periods in between monitored trigger storms. A subcontracted litter laboratory was used to analyze litter samples in accordance with the Caltrans Standard Litter Laboratory Analysis Method (2000-2001).

2001-2002 Monitoring Results

- Season air dried litter loads ranged from 1.6 to 10.4 kilograms/hectare (kg/ha) for the 5 site groups, SR180, SR41, SR99, and SR180 in Fresno and I5 in Stockton. By volume, loads ranged from 32. 5 to 134.0 liters/ha. These loads are higher than seasonal loads from the first year of monitoring, which ranged from 0.8 to 4.9 kg/ha (16.3 to 93.4 liters/ha) for the site groups monitored October 2000 through April 2001.
- The majority of material collected in gross pollutant samples was vegetation. The percent litter in gross pollutants collected for the 2001-2002 season at the five site groups ranged from 5 to 18 percent by weight and 11 to 43 percent by volume.

- Fifteen separate storm events were monitored in Fresno between September 15, 2001 and May 1, 2002. Total seasonal rainfall for the monitored period was 189.7 millimeters (mm).
- Seventeen separate storm events were monitored in Stockton during the same period. Total seasonal rainfall for this period in Stockton was 302mm.
- The historical average total rainfall for the months of September through April is 244 mm and 295 mm in Fresno and Stockton, respectively.

SECTION ONE

1.1 BACKGROUND

This report presents results of storm water litter monitoring for the Caltrans Litter Public Education Litter Monitoring Study (PELMS) for the 2001-2002 rain season. Storm water litter monitoring was conducted at 14 sites in Fresno and 2 sites in Stockton in accordance with the PELMS Sampling and Analysis Plan (SAP; Caltrans 2000a, 2001a). The PELMS SAP was developed following the Caltrans Guidance Manual: Storm Water Monitoring Protocols (Caltrans 2000b) and the Caltrans Guidance for Monitoring Storm Water Litter (Caltrans 2000c). The purpose of the PELMS is to monitor litter before and after implementation of a public education litter program as part of the Caltrans Public Education Research Study (PERS). The objective of the PERS is to assess the changes that may occur in storm water litter after implementation of a targeted public education program. The PERS is being conducted by Caltrans as stipulated in Section 6 of the Caltrans Storm Water Management Plan (SWMP; Caltrans 2000d), which specifically identifies Fresno as the required study city.

Storm water litter monitoring conducted during the 2001-2002 rain season represents the second season of storm water litter monitoring in support of the PERS. The first season, 2000-2001, represents the first year of baseline monitoring to assess conditions before implementation of the public education campaign. The PERS public education campaign includes multimedia advertising (radio, television, and billboard advertising, and sponsorships) with targeted anti-litter messages and was initiated in February 2002. It is anticipated that data from the 2001-2002 season will be used as a second season of baseline monitoring. Although the public education program was initiated partway through the season, littering behavior is not expected to change substantially for several months after program initiation.

An additional evaluation method was added to the program for the 2001-2002 season. In addition to conducting storm water litter monitoring, roadside litter quantities are being tracked through the Caltrans Maintenance Management System (MMS) within the PERS project area. Evaluation of MMS roadside litter data has been added to the overall PERS monitoring program to supplement storm water litter monitoring and provide an additional tool for program assessment. Like storm water litter monitoring, data tracked through the MMS system will be compared from periods before and after public education implementation to assess any change in roadside litter quantities. This evaluation will consider five to six years of baseline data (1996 to early 2002). Data before 1995 may be available but will not be included in the analysis, because of substantial changes in freeways and overall growth in the Fresno area. Baseline data will then be compared to maintenance collection totals from mid to late 2002 and 2003 and results will be presented in future reports.

1.2 MONITORING SITES

Table 1-1 lists the 16 storm water litter sites monitored for the 2001-2002 rain season. These sites are consistent with sites monitored during the 2000-2001 season, except for one site, SR41-PE5, which was monitored during the first portion of the 2000-2001 season and then abandoned because of recurrent flooding problems at the site. Therefore, no data are presented for this site in this report. The 14 Fresno-area sites and 2 Stockton sites are shown on Figures 1-1 and 1-2, respectively. Eight sites are in central Fresno in two general areas, on State Route (SR) 41 near

Shields Avenue (Figure 1-3) and on SR 180 near Blackstone Avenue (Figure 1-4). Both of these areas are within the metropolitan core of the city and in both areas, runoff is monitored from freeway catchment areas. Two sites are on Kings Canyon Road (Old SR 180 – Figures 1-5 and 1-6) and monitor surface highway runoff in areas with mixed local traffic (residential, commercial, pedestrian, and bicycle). Four sites are on SR 99 (Figures 1-7 to 1-10) and monitor storm water litter from areas with substantial through-traffic (non-local). Photographs of surface conditions of the contributing runoff area at each site are provided in Appendix A. Two Stockton sites (Figure 1-11) were monitored on Interstate 5 (I5) to collect litter data in a control area, outside the public education implementation region, to assess seasonal litter load variation.

Table 1-1 lists general characteristics for each site, including location, the monitored catchment area size, and average annual daily traffic (AADT) values for 1999, 2000, and 2001. When the original sites were identified in 2000, 1999 AADT data for the site roadways were available. Additional years of AADT have since become available. Most of the site roadways have had small increases in AADT, typically less than 3 percent between 2000 and 2001. SR 180, however, near sites SR180-PE1 through SR180-PE4, has seen an approximately 22 percent increase in AADT between 2000 and 2001. This is likely because of the opening of a new freeway in Fresno in late 2000 and early 2001, SR 168, that connects with SR 180. Although a relationship between AADT and storm water litter load has not been clearly identified in previous studies, this increase is noted.

SECTION ONE

Introduction

Table 1-1
STORM WATER LITTER MONITORING SITE LOCATIONS (2001–2002)

| Site ID | General Location | Freeway | Freeway Direction | Approximate Post Mile | 1999 AADT ⁽¹⁾ | 2000 AADT ⁽¹⁾ | 2001 AADT ⁽¹⁾ | Field-Verified Watershed Area (hectares) |
|------------|------------------|------------|-------------------|-----------------------|--------------------------|--------------------------|--------------------------|------------------------------------------|
| SR180-PE1 | Fresno | SR 180 | East | 180FRE57.76 | 41,000 | 54,000 | 66,000 | 0.68 |
| SR180-PE2 | Fresno | SR 180 | East | 180FRE 57.81 | 41,000 | 54,000 | 66,000 | 0.75 |
| SR180-PE3 | Fresno | SR 180 | East | 180FRE57.89 | 41,000 | 54,000 | 66,000 | 0.20 |
| SR180-PE4 | Fresno | SR 180 | East | 180FRE57.95 | 41,000 | 54,000 | 66,000 | 0.41 |
| SR41-PE6 | Fresno | SR 41 | North | 41FRE26.08 | 118,000 | 119,000 | 122,000 | 0.13 |
| SR41-PE7 | Fresno | SR 41 | South | 41FRE26.08 | 118,000 | 119,000 | 122,000 | 0.42 |
| SR41-PE8 | Fresno | SR 41 | North | 41FRE26.21 | 118,000 | 119,000 | 122,000 | 0.41 |
| I5-PE9 | Stockton | I5 | North | 5SJ29.25 | 86,000 | 87,000 | 88,000 | 0.41 |
| I5-PE10 | Stockton | I5 | North | 5SJ29.33 | 86,000 | 87,000 | 88,000 | 0.22 |
| SR99-PE11 | Fresno | SR 99 | South | 99MAD 7.2 | 52,000 | 53,000 | 55,000 | 0.15 |
| SR99-PE12 | Fresno | SR 99 | North | 99FRE 31.5 | 59,000 | 60,000 | 61,000 | 0.15 |
| SR99-PE13 | Fresno | SR 99 | North | 99FRE 1.5 | 45,000 | 45,000 | 46,000 | 0.27 |
| 6-06 | Fresno | SR 99 | South | 99TUL 53.5 | 44,500 | 45,000 | 46,000 | 0.10 |
| SR180-PE14 | Fresno | Old SR 180 | East | N/A | 38,000 | 38,000 | 38,000 | 1.07 |
| SR180-PE15 | Fresno | Old SR 180 | East | N/A | 38,000 | 38,000 | 38,000 | 0.27 |
| SR41-PE16 | Fresno | SR 41 | South | 41FRE 26.3 | 118,000 | 119,000 | 122,000 | 0.15 |

NOTES:

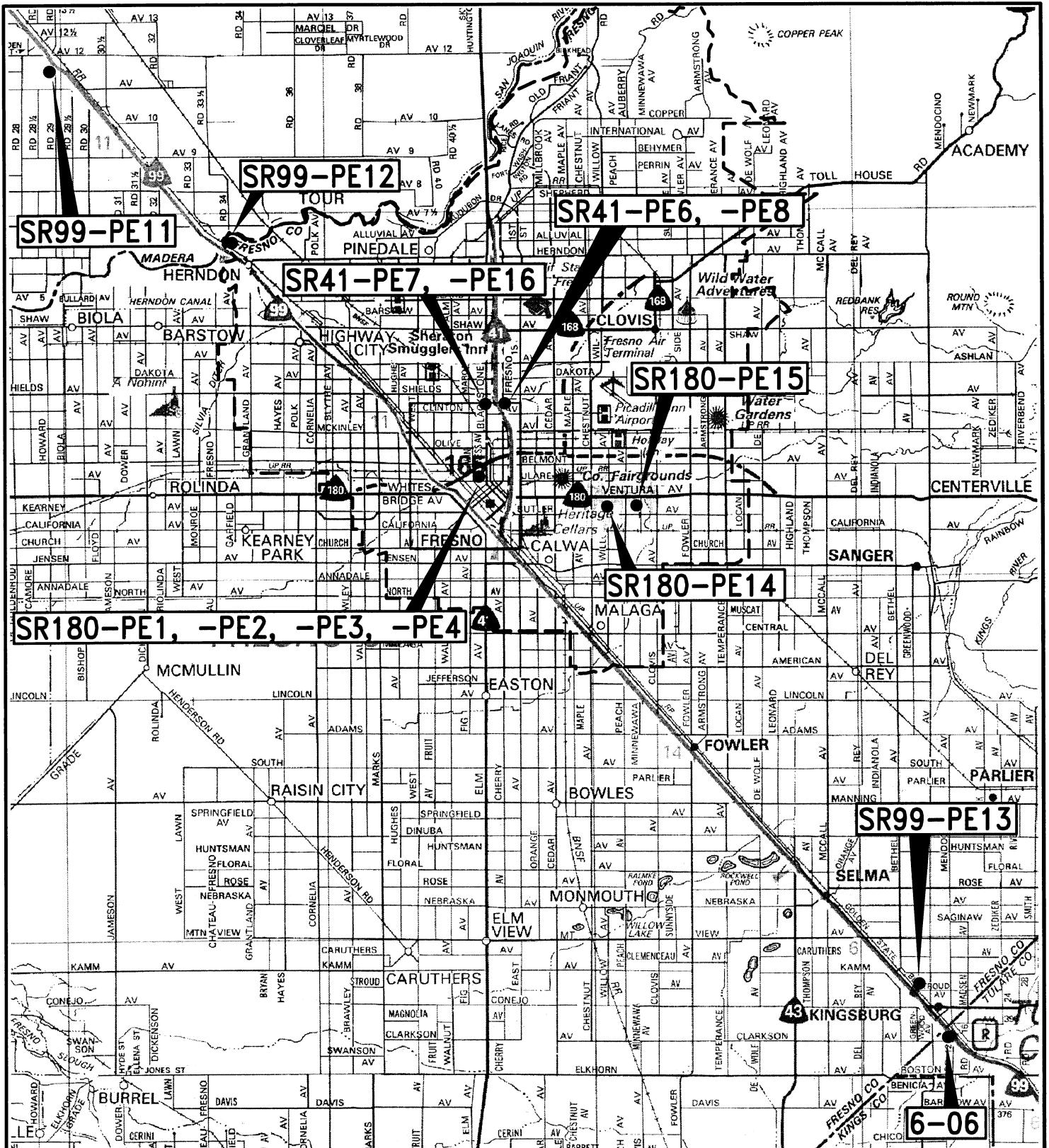
SR = State Route

PE = Public Education

FRE = Fresno County

(1) AADT source: <http://www.dot.ca.gov/hq/traffops/ssafest/trafdata>. The traffic count year is from October 1 through September 30.

SJ = San Joaquin County
MAD = Madera County
TUL = Tulare County



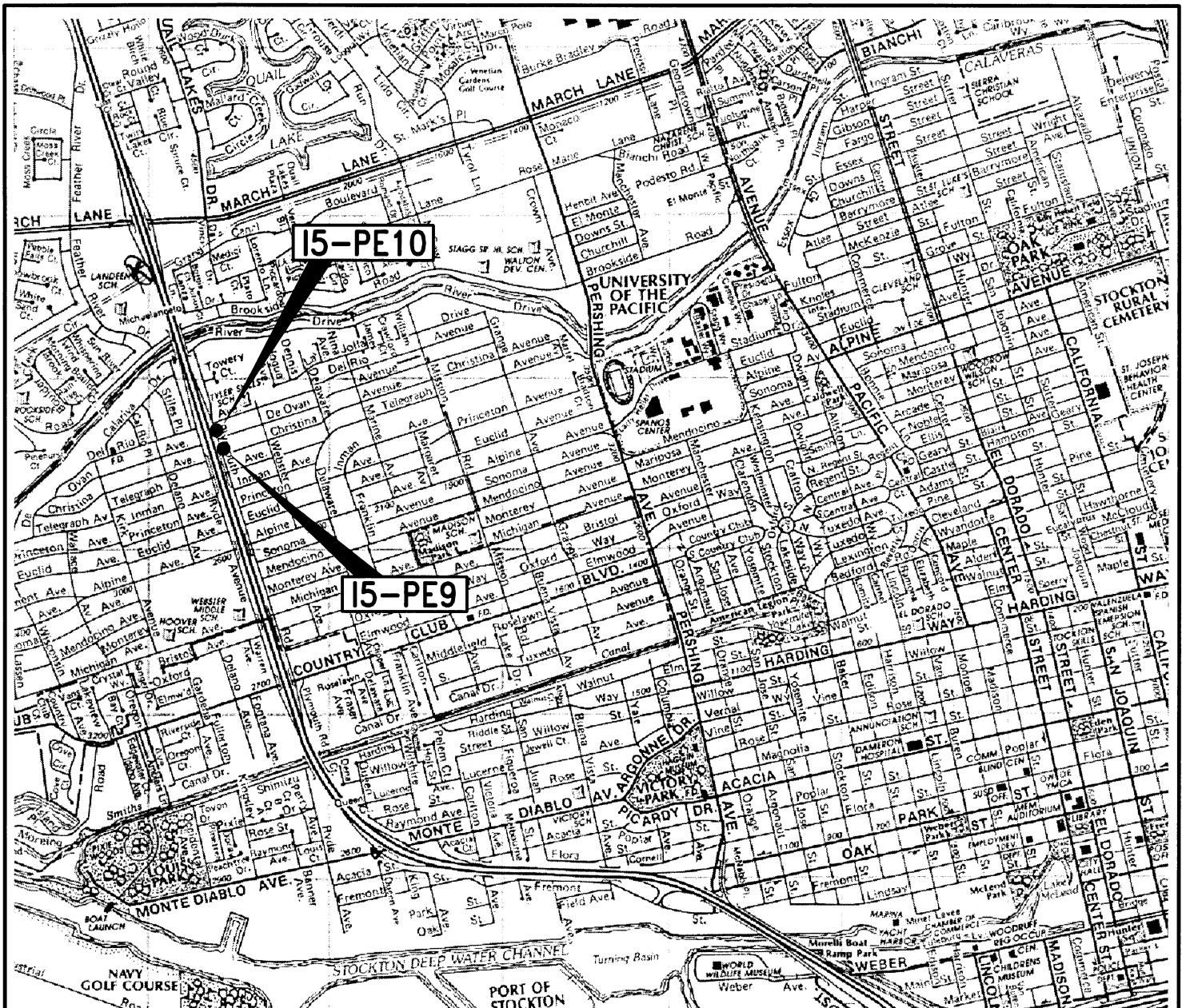
LEGEND:

● PELMS MONITORING LOCATION

0 4 8

APPROXIMATE GRAPHIC SCALE
(MILES)

| CALTRANS PELM STUDY FRESNO MONITORING SITE LOCATIONS | | DATE: JUNE 2002 | FIG. NO: 1-1 |
|---------------------------------------------------------|--|--------------------|-----------------|
| | | | |



LEGEND:

● PELMS MONITORING LOCATION

0 2500 5000

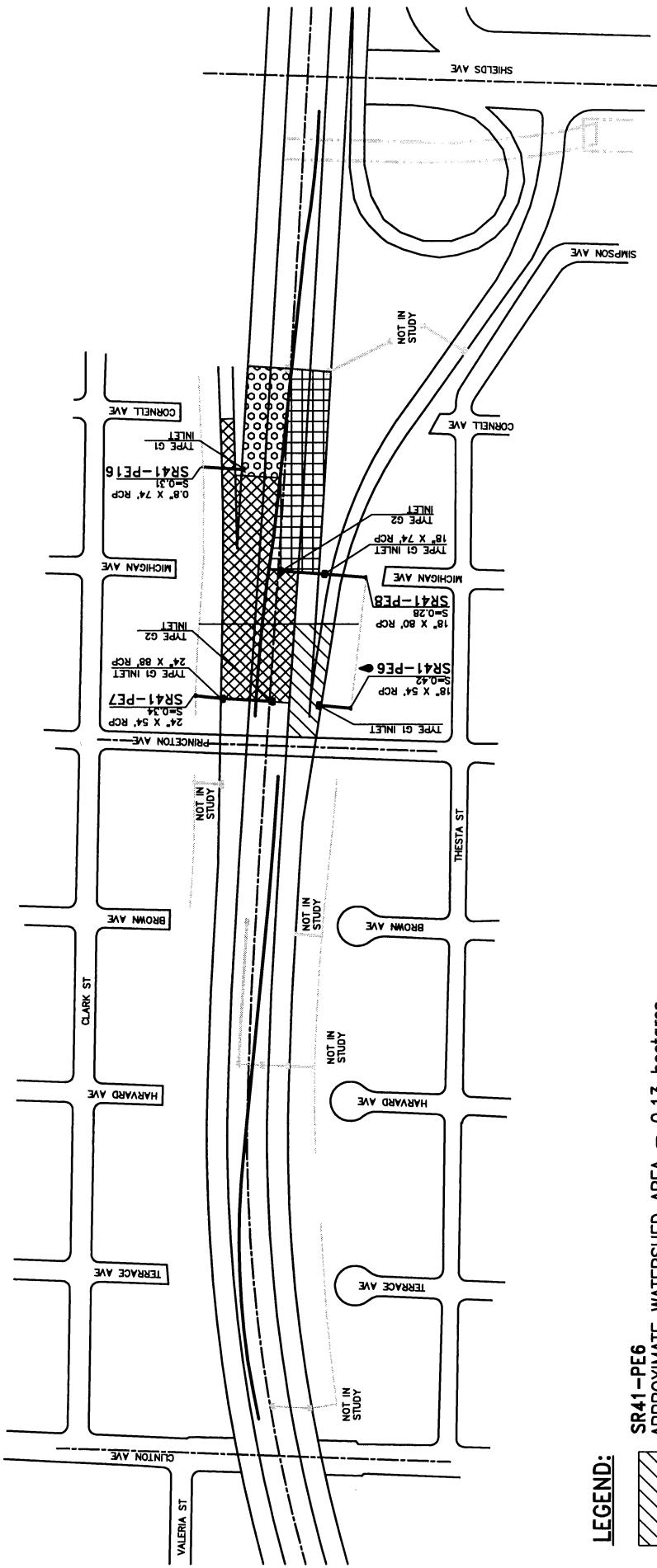
APPROXIMATE GRAPHIC SCALE
(FEET)



CALTRANS PELM STUDY STOCKTON MONITORING SITE LOCATIONS

DATE:
JUNE 2002

FIG. NO:
1-2



LEGEND:

- SR41-PE6 APPROXIMATE WATERSHED AREA = 0.13 hectares
- SR41-PE7 APPROXIMATE WATERSHED AREA = 0.42 hectares
- SR41-PE8 APPROXIMATE WATERSHED AREA = 0.41 hectares
- SR41-PE16 APPROXIMATE WATERSHED AREA = 0.15 hectares

CHEMICAL WATER QUALITY MONITORING LOCATION

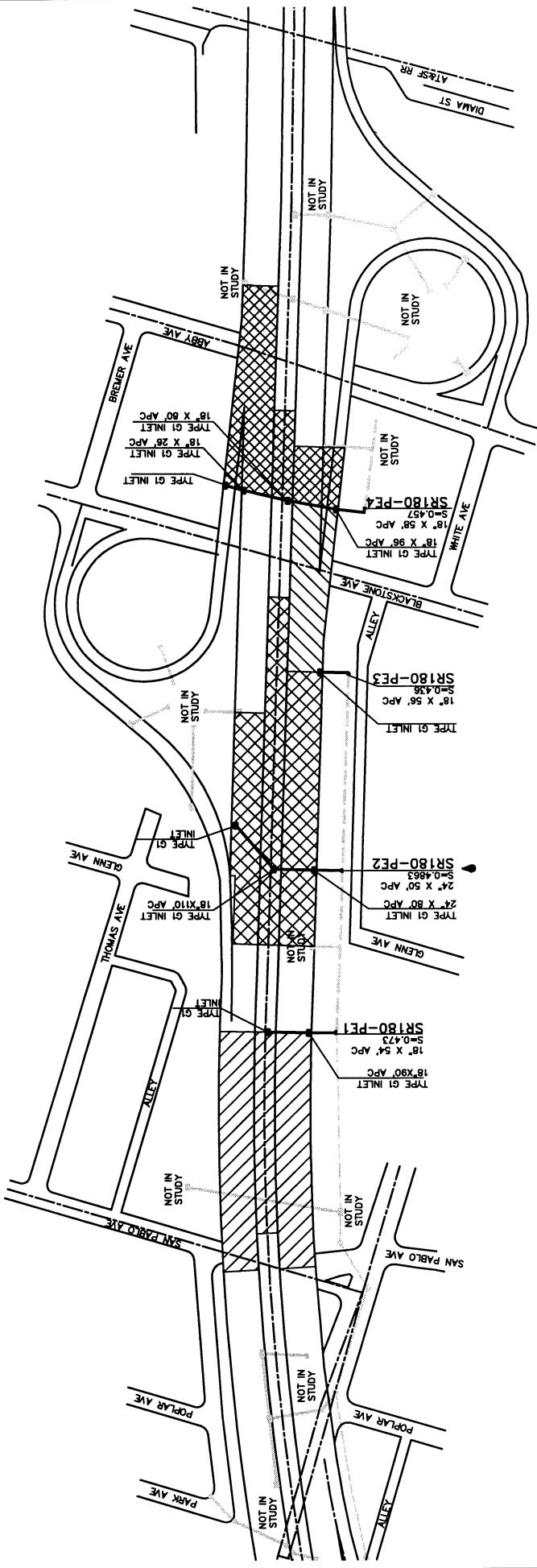


APPROXIMATE GRAPHIC SCALE
(FEET)

0 300 600

CALTRANS PELM STUDY
FRESNO MONITORING SITES
STATE ROUTE 41

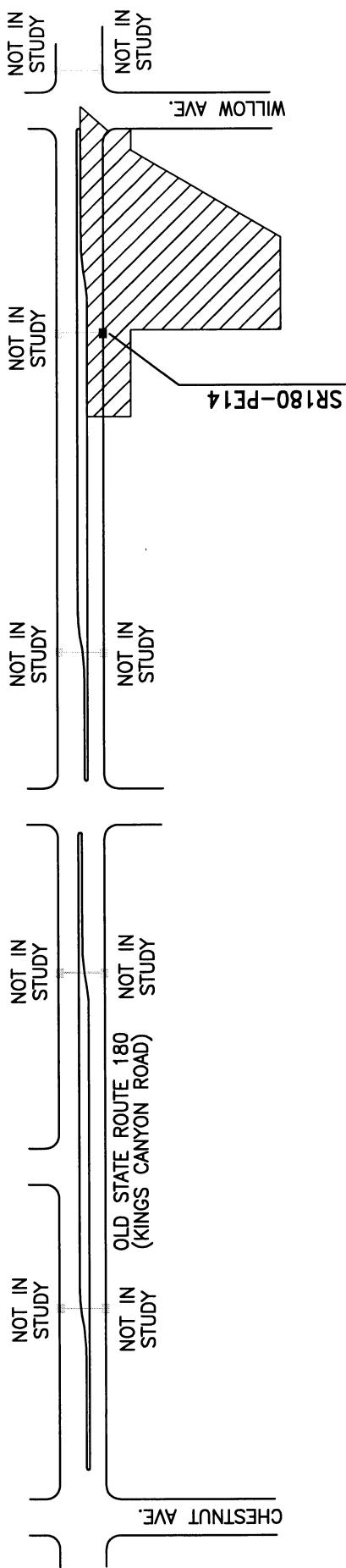
| | |
|-----------------|--------------------|
| FIG. NO: 1-3 | DATE: JUNE 2002 |
|-----------------|--------------------|



CALTRANS PELM STUDY
FRESNO MONITORING SITES
STATE ROUTE 180

0 300 600
APPROXIMATE GRAPHIC SCALE (FEET)

| | |
|-----------------|--------------|
| DATE: JUNE 2002 | FIG. NO: 1-4 |
|-----------------|--------------|



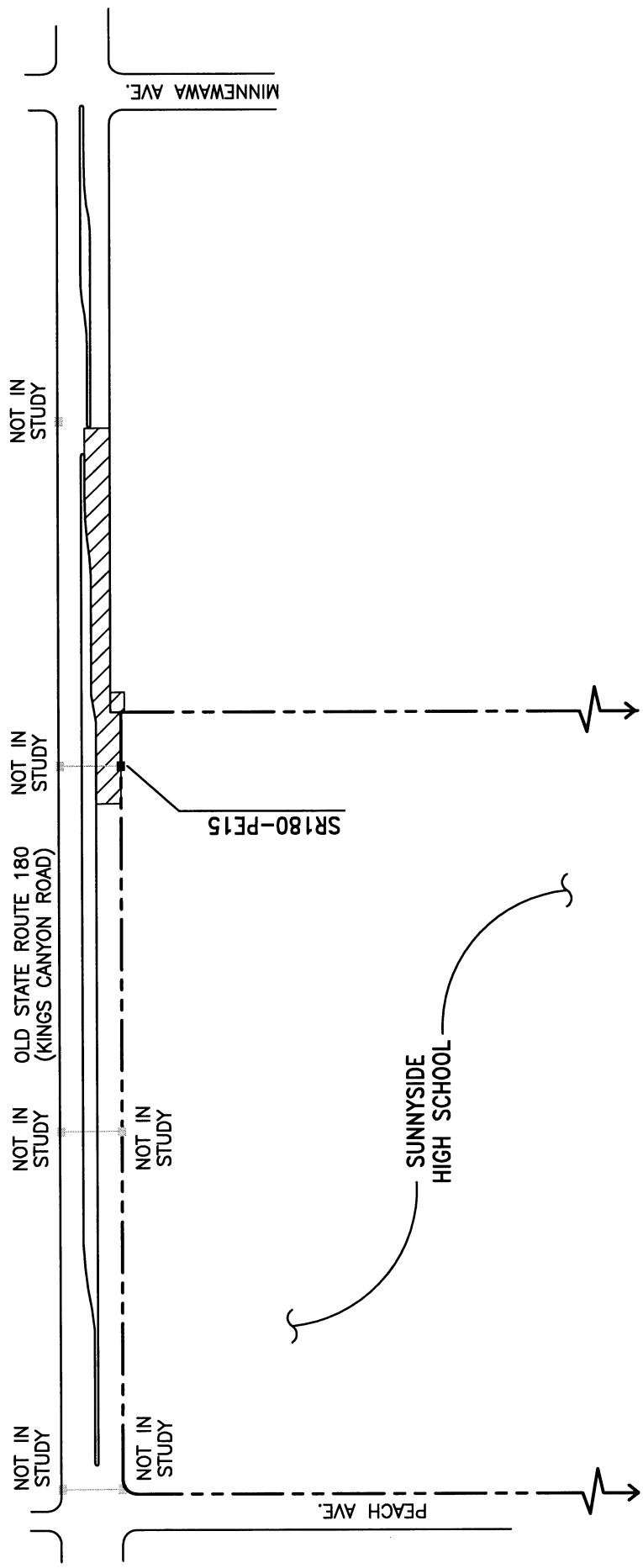
LEGEND:

SR180-PE14 APPROXIMATE WATERSHED AREA = 1.07 hectares

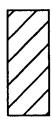


CALTRANS PELM STUDY
FRESNO MONITORING SITE SR180-PE14
OLD STATE ROUTE 180

| | |
|-----------------|--------------|
| DATE: JUNE 2002 | FIG. NO: 1-5 |
|-----------------|--------------|



LEGEND:

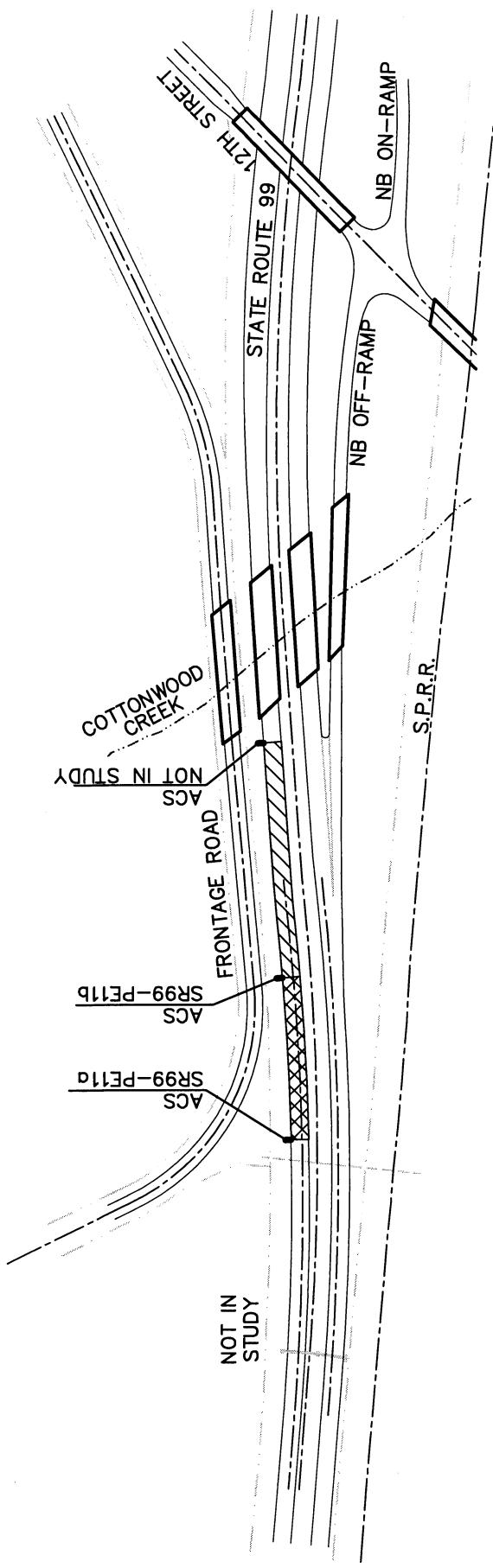


SR180-PE15
APPROXIMATE WATERSHED AREA = 0.27 hectares



CALTRANS PELM STUDY
FRESNO MONITORING SITE SR180-PE15
OLD STATE ROUTE 180

| | |
|--------------------|-----------------|
| DATE: JUNE 2002 | FIG. NO: 1-6 |
|--------------------|-----------------|



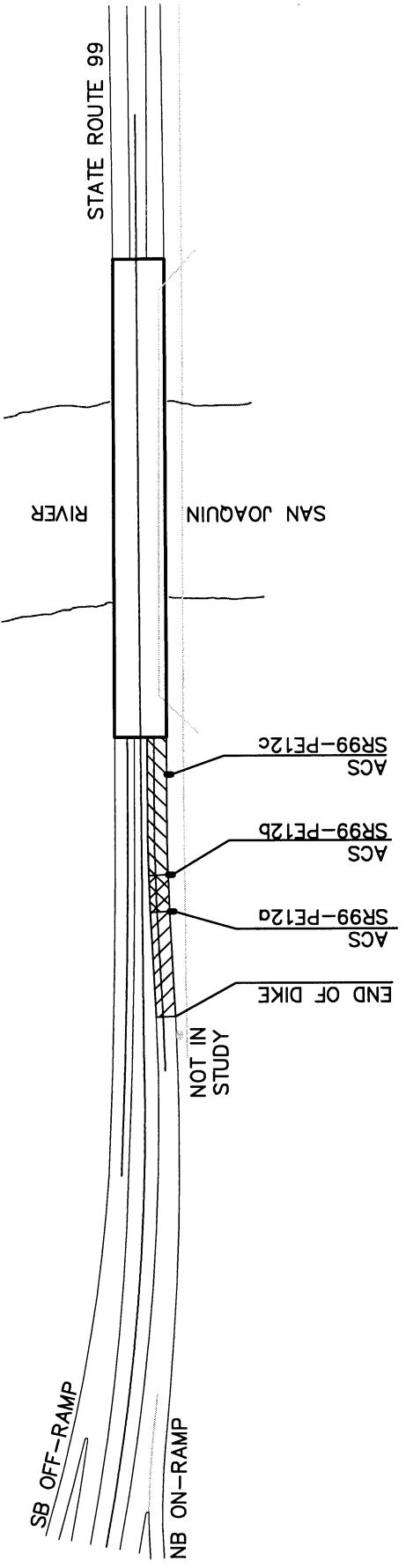
LEGEND:

- [Cross-hatched square] SR99-PE11a APPROXIMATE WATERSHED AREA = 0.06 hectares
- [Diagonal-hatched square] SR99-PE11b APPROXIMATE WATERSHED AREA = 0.09 hectares
- ACS ASPHALT CONCRETE SPILLWAY

CALTRANS PELM STUDY
FRESNO MONITORING SITE SR99-PE11
STATE ROUTE 99

0 300 600
APPROXIMATE GRAPHIC SCALE
(FEET)

FIG. NO:
1-7
DATE:
JUNE 2002



APPROXIMATE GRAPHIC SCALE (FEET)

| | | |
|---|-----|-----|
| 0 | 300 | 600 |
|---|-----|-----|

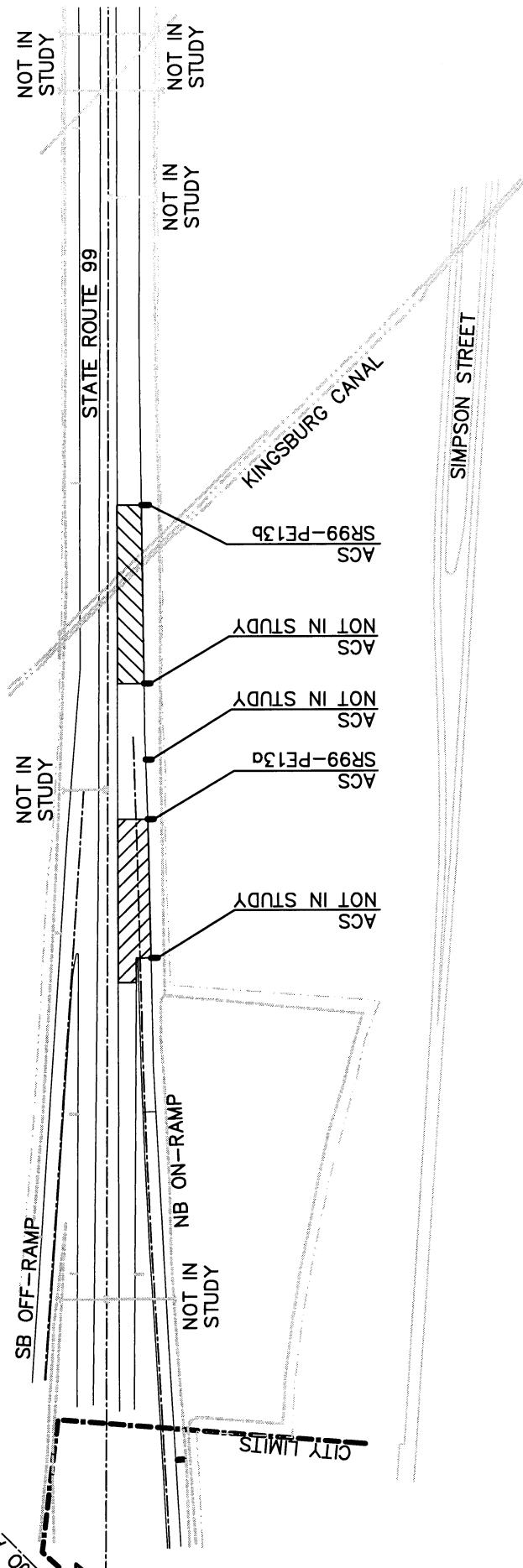


CALTRANS PELM STUDY
FRESNO MONITORING SITE SR99-PE12
STATE ROUTE 99

0 300 600

APPROXIMATE GRAPHIC SCALE (FEET)

| | |
|-----------------|--------------|
| DATE: JUNE 2002 | FIG. NO: 1-8 |
|-----------------|--------------|

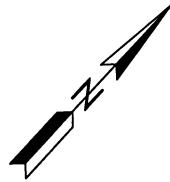


LEGEND:

SR99-PE13a APPROXIMATE WATERSHED AREA = 0.14 hectares

SR99-PE13b APPROXIMATE WATERSHED AREA = 0.13 hectares

ACCS ASPHALT CONCRETE SPILLWAY



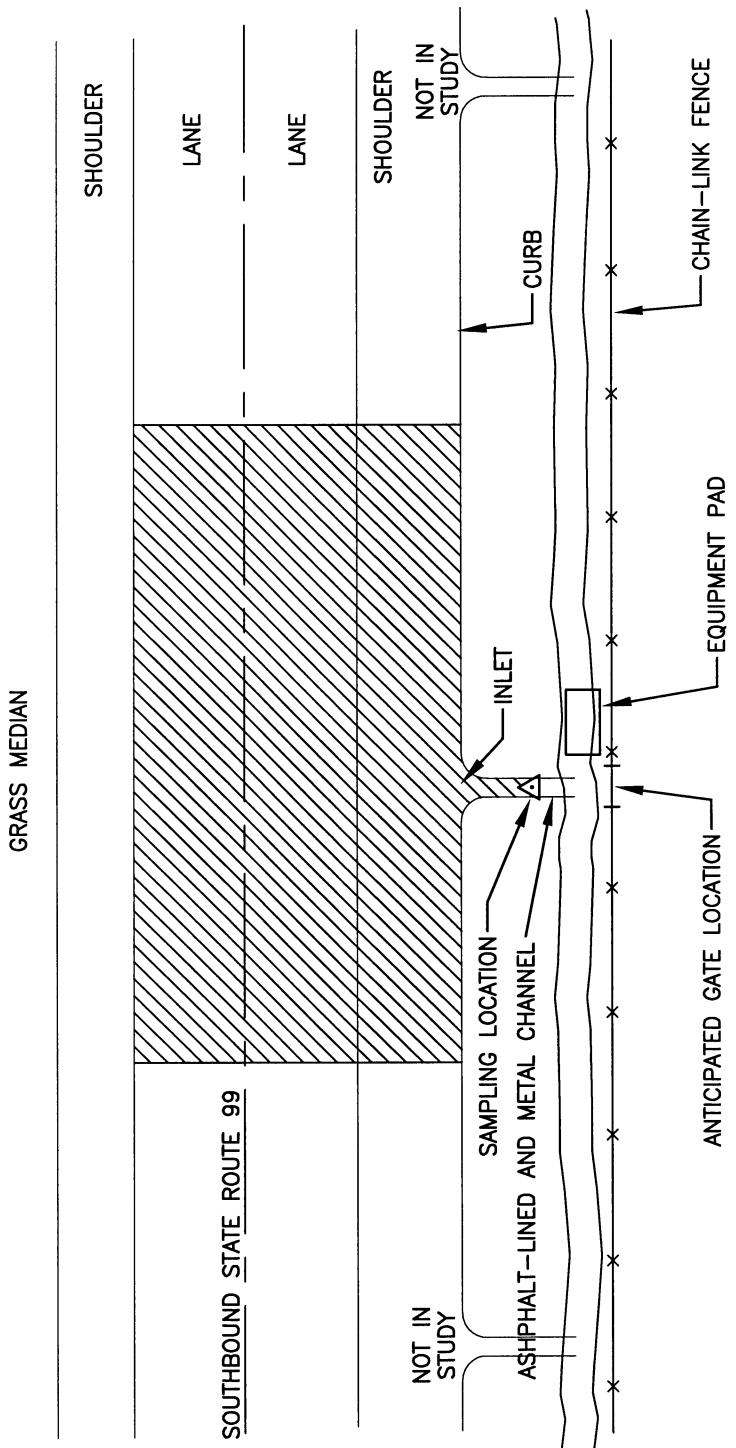
APPROXIMATE GRAPHIC SCALE
(FEET)



0 300 600

**CALTRANS PELM STUDY
CALTRANS MONITORING SITE SR99-PE13
STATE ROUTE 99**

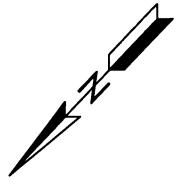
FIG. NO:
1-9



LEGEND:



6-06 APPROXIMATE WATERSHED AREA = 0.10 hectares

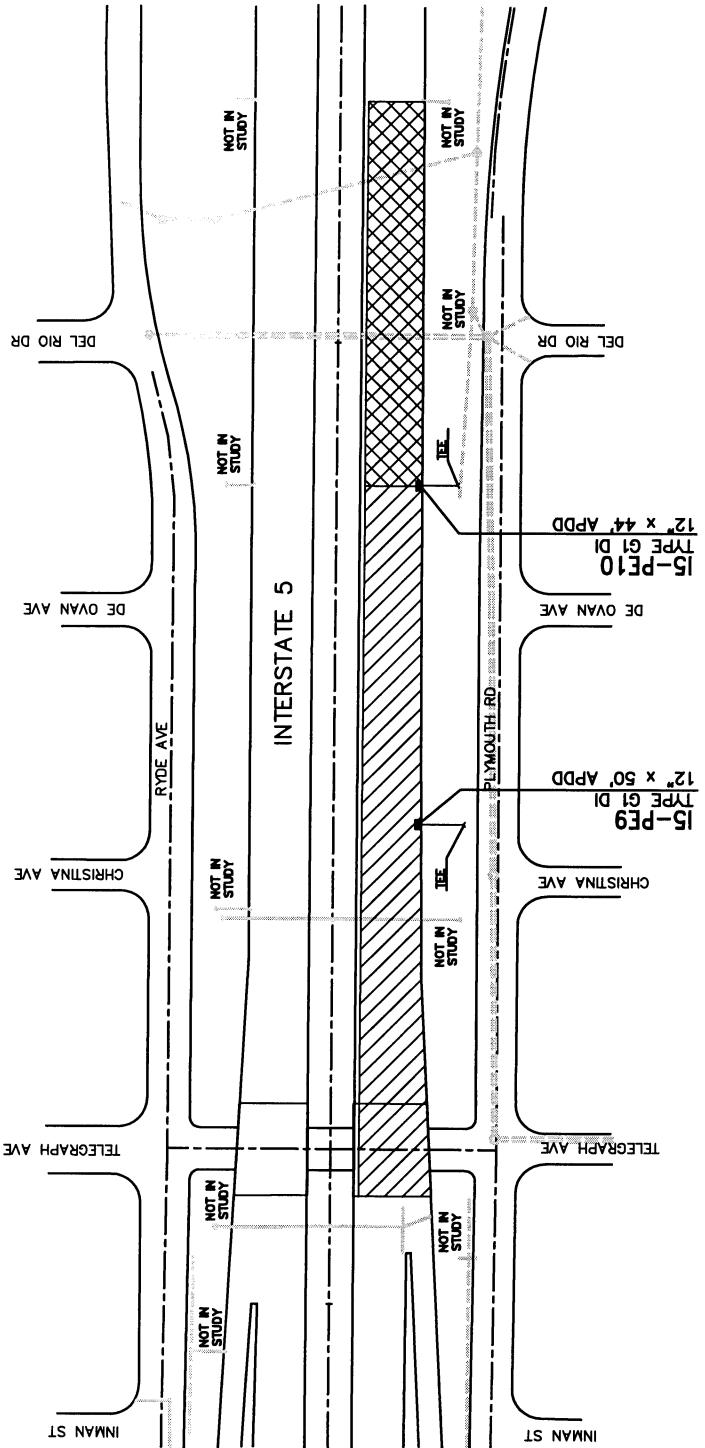


NOT TO SCALE

REFERENCE: CALTRANS DOCUMENT NO. CTSW-RT-00-033.

CALTRANS PELM STUDY
CALTRANS MONITORING SITE 6-06
STATE ROUTE 99

DATE: JUNE 2002 FIG. NO:
1-10



LEGEND:

- 15-PE9 APPROXIMATE WATERSHED AREA = 0.41 hectares
- 15-PE10 APPROXIMATE WATERSHED AREA = 0.22 hectares



0 200 400

APPROXIMATE GRAPHIC SCALE
(FEET)

CALTRANS PELM STUDY
STOCKTON MONITORING SITES
INTERSTATE 5

| | |
|--------------------|------------------|
| DATE: JUNE 2002 | FIG. NO: 1-11 |
|--------------------|------------------|

SECTION TWO

This section describes the monitoring equipment used for storm water litter monitoring, summarizes hydrologic data collected for each event, and discusses the general approach used in analysis and Quality Assurance/Quality Control (QA/QC) of the data for all events monitored during the 2001-2002 rain season.

2.1 MONITORING EQUIPMENT AND PROCEDURES

Storm water litter monitoring was conducted using two basic types of litter collection devices, outfall monitoring bags and curb inlet monitoring baskets. Event monitoring procedures consisted of visiting each site prior to a predicted storm event to install an empty monitoring bag and collect any gross pollutants (litter and vegetation) that had accumulated since the last monitored storm. Litter monitoring bags were collected after each monitored event and replaced with empty bags. Detailed litter monitoring procedures are provided in the PELMS SAP (Caltrans 2000a, 2001a).

Outfall monitoring bags were used at all freeway sites and consisted of a 5-mm ($\frac{1}{4}$ -inch) mesh bag attached to each outfall. Mesh bags were attached to pipes directly for concentric corrugated pipe or via metal collars attached to concrete or non-concentric corrugated pipe. The litter bags were secured to the pipes/collars with nylon belt straps. Buckle straps were used to facilitate the removal. Photo 2-1 shows an outfall monitoring bag set-up typical of the sites located on SR 41, SR 180 and I5. Photo 2-2 shows an outfall/modified standard taper entrance set-up typical of the sites on SR 99. A chain-link protective enclosure surrounds the monitoring equipment at sites located on SR 41, SR 180 and I5.

For surface road sites, litter monitoring was conducted in two curb drain inlets located along Old SR 180, also known as Kings Canyon Road. The litter monitoring device used at curb inlets is shown in Figure 2-1 and Photo 2-3. Litter monitoring baskets are lined with 5-mm ($\frac{1}{4}$ inch) mesh bags and act as a strainer to capture litter present in water flowing into the inlet. The litter monitoring basket design also allows water bypass or overflow during high flow conditions or if litter bags become full. Litter monitoring basket frames were bolted to three walls of the drain inlet, below the bottom of the drain inlet and extending 1 foot into the inlet, leaving a minimum 1 foot for water overflow. Litter bags were suspended from the frame basket and secured by placing a plate over the frame. The plate was then attached to the frame by cotter pins.

Rainfall was recorded using automatic tipping bucket rain gauges at three locations, SR180-PE2, SR41-PE6, and the Stockton I5-PE10 site. Storm water flow was recorded using Sigma 950 bubbler flow-meters and 1.5-foot H-flumes at two sites, SR180-PE2 and SR41-PE6.

2.2 EVENT AND HYDROLOGIC DATA SUMMARY

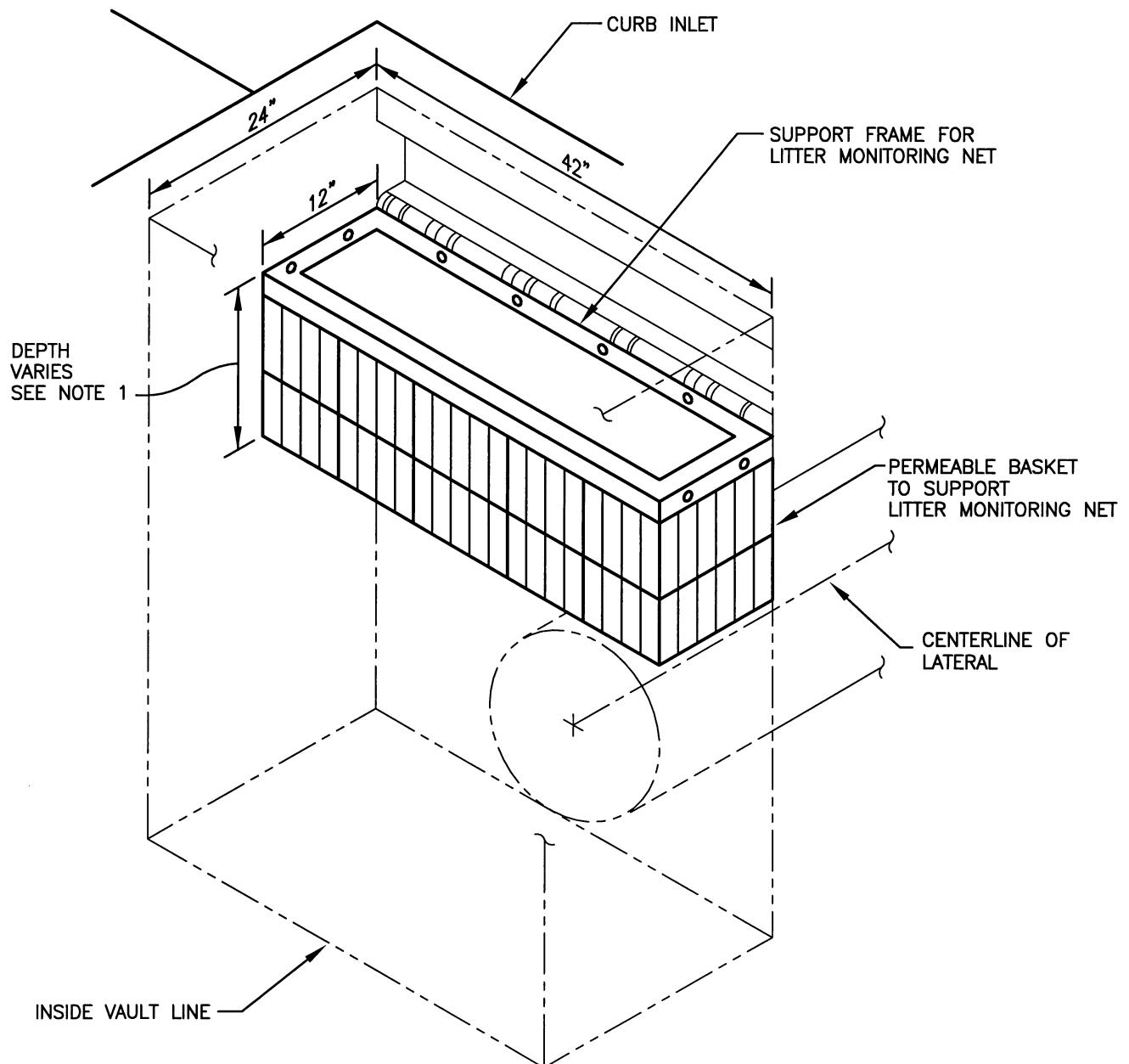
During the 2001-2002 rain season, fourteen storm events were monitored at the Fresno PELMS sites and seventeen storm events at the Stockton PELMS sites between September 24, 2001 and April 30, 2002. Rainfall and flow data were recorded for all events.

**Photo 2-1
OUTFALL MONITORING BAG SET-UP**



**Photo 2-2
OUTFALL/MODIFIED STANDARD TAPER ENTRANCE SET-UP**





NOTE:

- 1.) DEPTH EQUALS 8" FOR FRESNO METROPOLITAN FLOOD CONTROL DISTRICT INLET NO. 149 AND 18" FOR MFCD INLET NO. 132.

CALTRANS PELM STUDY
SITES SR180-PE14 AND SR180-PE15
TYPICAL CURB INLET LITTER MONITORING DEVICE

DATE:
JUNE 2002

FIG. NO:
2-1

Photo 2-3
LITTER MONITORING DEVICE USED AT CURB INLETS



2.2.1 Hydrologic Data Analysis Procedure

Throughout the PELMS, each station with flow and rainfall monitoring equipment recorded continuous flow and rain records at intervals of one measurement per minute and one measurement per five minutes, respectively. After each storm, hydrologic information was reviewed for each station and hydrographs for each event were prepared. Hydrographs were prepared using the Caltrans Hydrologic Utility computer program (version 1.8). Appendix B provides detailed event summaries generated by the computer program for each event monitored during the 2001-2002 rain season.

QA/QC of the raw data was performed to identify anomalies such as clogged rainfall gauges and flow meters or spikes in the flow record unrelated to rainfall increases. Analysis and QA/QC procedures of the raw data consisted of the following steps:

1. Generate hydrographs, hyetographs, and summaries for each storm at each outfall including: peak rainfall intensity (based on 5-minute rainfall data), total precipitation, total flow volume, total depth of flow (watershed millimeters), peak flow rate, and the beginning and ending time and date for each event based on the Caltrans definition of a storm event. These hydrologic summary data and charts were generated using the Caltrans Hydrologic Utility.
2. Assess hydrographs and hyetographs to identify instances where flow rate, change in flow rate, or flow duration appeared to be outside expected ranges.
3. Compare rainfall observations (i.e., total depths and hyetographs) at each site to other sites and National Weather Service (NWS) data to identify data anomalies.

4. Prepare and assess graphs that plot runoff as a function of rainfall for all storm events over the rain season. Regression analysis was conducted on these plots to identify potential outliers that might indicate additional anomalies in the data record. Outliers were examined to identify specific anomalies in rainfall or flow.
5. Update rainfall totals (i.e., use rainfall totals from nearby stations to estimate total rainfall for any rain gauge that was not functioning correctly).
6. Flag and remove data outliers for final regression analysis.
7. Calculate runoff coefficients using regression analysis of the final data set and other hydrologic summary information.

Final hydrologic data summaries provided in Appendix B were prepared to reflect any changes resulting from the QA/QC analysis procedures listed above.

2.2.2 Event and Total Seasonal Hydrologic Data

Hydrologic characteristics of storm events monitored during the 2001-2002 rain season are summarized in Table 2-1. These characteristics include total rainfall depth, event start and stop times (based on litter sample collection), event duration, maximum rainfall intensity, and antecedent rain conditions. The antecedent rain condition refers to the number of days since the last storm event larger than 2.5 millimeters and the total amount of rain that occurred during that period. Event start and stop times, total rain, and sample duration are defined by the first and last rain readings for the period that the event litter collection bag was in place at the outfall. These values consider all rain that occurred during this period. This criteria differs from the definition of a water quality storm event in the Caltrans Data Reporting Protocols, which does not consider leading or trailing rainfall that is separated from the main event by six hours or more. However, these leading or trailing portions of an event contribute to the total gross pollutant sample and are included in the summary data in Table 2-1.

Due to rainfall data abnormalities observed at SR41-PE6, all Fresno hydrologic data presented in Table 2-1 are from SR180-PE2. Abnormalities were observed at SR41-PE during Events 2001-03 through 2001-06 because of a malfunction of the tipping bucket arm within the rain gauge. Once the problem was correctly identified and fixed, the gauge worked correctly for the subsequent events. Any additional monitoring related abnormalities are described on the event summaries in Appendix B. Rainfall and flow characteristics included in the event summaries are based on storm event start and stop times as determined by the Caltrans Hydrologic Utility and do not necessarily include all rainfall and flow associated with the litter sample collection event. For example, in some cases small amounts of rain and flow would occur prior to or after the significant, defined portion of a storm event. In all cases, the data presented in the event summaries include the peak intensity, maximum flow rate, and major portion of the sampled hydrograph.

Tables 2-2 and 2-3 present event flow totals for Fresno and Stockton litter monitoring sites, respectively. Flow totals were estimated for all sites based on event rainfall totals, site catchment areas, and estimated runoff coefficients. Runoff coefficients for all monitoring stations were estimated based on storm event field observations, as-built map analysis, and rainfall versus

runoff relationships (for stations SR180-PE2 and SR41-PE6). The analysis assumed that sites adjacent to a flow monitoring station were hydraulically similar and utilized the same runoff coefficient. Flow totals were calculated based on total event rainfall in Table 2-1. These flow data may be useful in future analysis of litter and flow relationships.

2.2.3 Total Seasonal Rainfall Data

Rainfall gauges recorded precipitation during and in between rainfall events which provides a total seasonal rainfall record. Table 2-4 shows the monthly and total rainfall for each site as well as a NWS station in proximity to the monitoring sites. Monthly rainfall totals at the monitored sites are generally consistent with monthly totals from nearby NWS gauges. Most monthly totals differed by less than 5mm. During March 2002 in Fresno, the gauge at SR180-PE2 recorded over 8mm more rain than the corresponding NWS gauge. This is likely due to the high intensity and erratic nature of Event 2001-17 (March 23, 2002). During December 2001, the monthly totals for Stockton differed by 9.2mm; however, the total rainfall was twice the historical average and the difference represents less than 8 percent of the total monthly rainfall.

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Table 2-1
SUMMARY OF HYDROLOGIC DATA FOR MONITORED STORM EVENTS

| Event | Location | Total Rain (mm) | Rain Start | Rain End | Sample Duration (days) | Antecedent Dry Days | Antecedent Rain (mm) | Max Rainfall Intensity (mm/hr) | Notes |
|---------|-----------------|-----------------|----------------------------------|----------------------------------|------------------------|---------------------|----------------------|--------------------------------|--------|
| 2001-01 | Stockton | 4.3 | 9/24/01 20:20 | 9/25/01 10:20 | 0.58 | 67.9 | 0 | 3.0 | Note 1 |
| 2001-02 | Fresno Stockton | 9.1 9.9 | 10/30/01 3:45 10/30/01 2:35 | 10/30/01 14:30 10/31/01 13:20 | 0.45 1.45 | 103.2 35.1 | 0 0.25 | 12.2 6.1 | Note 2 |
| 2001-03 | Fresno Stockton | 25.1 20.6 | 11/12/01 13:25 11/10/01 4:00 | 11/12/01 21:00 11/13/01 15:00 | 0.32 3.46 | 1.5 14.4 | 10.4 0 | 18.3 N/A | Note 2 |
| 2001-04 | Fresno Stockton | 3.3 4.1 | 11/22/01 8:00 11/21/01 12:35 | 11/22/01 9:05 11/22/01 13:25 | 0.05 | 9.5 | 0.25 | 6.1 | |
| 2001-05 | Fresno Stockton | 8.1 16.8 | 11/24/01 8:35 11/24/01 5:55 | 11/24/01 15:25 11/25/01 9:00 | 0.28 1.03 | 2.0 7.5 | 0.25 | 3.0 | |
| 2001-06 | Fresno Stockton | 7.1 7.6 | 11/28/01 23:00 11/28/01 19:00 | 11/29/01 11:40 11/29/01 22:00 | 0.53 | 4.3 | 0 | 9.1 | |
| 2001-07 | Fresno Stockton | 4.1 24.9 | 12/1/01 16:10 12/1/01 2:00 | 12/2/01 16:25 12/3/01 6:00 | 1.01 2.17 | 2.2 1.0 | 0 | 6.1 | |
| 2001-08 | Fresno Stockton | 4.8 2.8 | 12/14/01 3:15 12/14/01 17:20 | 12/14/01 9:30 12/17/01 1:45 | 0.26 2.35 | 12.2 10.8 | 0.76 2.54 | 6.1 3.0 | Note 2 |
| 2001-09 | Stockton | 2.0 | 12/17/01 7:35 | 12/19/01 5:15 | 1.90 | 13.6 | 0 | 3.0 | Note 1 |
| 2001-10 | Fresno Stockton | 6.6 23.6 | 12/20/01 5:55 12/19/01 12:35 | 12/25/01 7:40 12/25/01 13:20 | 5.07 6.03 | 5.9 15.6 | 0 0 | 0.6 12.2 | |

SECTION TWO

Event Monitoring

Table 2-1 (continued)
SUMMARY OF HYDROLOGIC DATA FOR MONITORED STORM EVENTS

| Event | Location | Total Rain (mm) | Rain Start | Rain End | Sample Duration (days) | Antecedent Dry Days | Antecedent Rain (mm) | Max Rainfall Intensity (mm/hr) | Notes |
|---------|----------|-----------------|----------------|---------------|------------------------|---------------------|----------------------|--------------------------------|--------|
| 2001-11 | Fresno | 3.1 | 12/28/01 13:40 | 12/30/01 1:55 | 1.51 | 7.4 | 0 | 0.9 | Note 3 |
| | Stockton | 110.0 | 12/27/01 18:50 | 1/3/02 7:45 | 6.54 | 4.5 | 0 | 12.2 | |
| 2001-12 | Fresno | 24.6 | 12/30/01 20:10 | 1/3/02 2:30 | 3.26 | 0.76 | 0 | 15.2 | |
| | Stockton | 3.3 | 1/26/02 22:45 | 1/27/02 15:00 | 0.68 | 23.8 | 1.02 | 3.0 | |
| 2001-13 | Fresno | 7.1 | 1/26/02 7:35 | 1/29/02 2:10 | 2.77 | 23.5 | 4.32 | 6.1 | |
| | Stockton | 11.4 | 2/16/02 22:25 | 2/17/02 13:50 | 0.64 | 20.3 | 0.51 | 24.4 | |
| 2001-14 | Fresno | 13.0 | 2/16/02 18:55 | 2/20/02 11:35 | 3.69 | 8.9 | 7.11 | 9.1 | |
| | Stockton | 14.7 | 3/6/02 10:00 | 3/7/02 18:25 | 1.35 | 16.8 | 0 | 15.2 | |
| 2001-15 | Fresno | 19.1 | 3/5/02 23:00 | 3/7/02 13:45 | 1.61 | 16.6 | 0.25 | 9.1 | |
| | Stockton | 8.4 | 3/13/02 19:35 | 3/17/02 11:55 | 3.68 | 6.2 | 0 | 6.1 | |
| 2001-16 | Fresno | 11.7 | 3/23/02 14:55 | 3/24/02 12:10 | 0.89 | 5.8 | 6.10 | 30.5 | Note 1 |
| | Stockton | 18.8 | 3/22/02 14:20 | 3/23/02 11:35 | 0.89 | 5.1 | 0 | 24.4 | |
| 2001-17 | Fresno | 5.1 | 4/17/02 4:55 | 4/17/02 7:00 | 0.09 | 24.4 | 0 | 9.1 | |
| | Stockton | 1.5 | 4/22/02 6:55 | 4/22/02 13:35 | 0.28 | 29.8 | 0 | 3.0 | |

Notes

1 Event was monitored in Stockton Only. Insufficient rain predicted or received in Fresno.

2 Data based on hourly data from NWS station 048558 (Stockton Fire Station) due to on-site rain gauge data logger error.

3 In Fresno, Event 2001-11 ended on December 31, and Event 2001-12 began on January 2. In Stockton, Event 2001-11 lasted from December 28 through January 2 with no discernable break in rainfall. Consequently, a separate Event 2001-12 did not occur in Stockton.

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**Table 2-2
TOTAL ESTIMATED EVENT FLOW VOLUME FOR STORM EVENTS AT FRESNO MONITORING SITES⁽¹⁾**

| Event ID | Fresno Event Rain ⁽²⁾ (mm) | Total Estimated Flow ⁽³⁾ (L) | | | | | | | | | | | | |
|----------|---------------------------------------|-----------------------------------------|-----------|-----------|-----------|----------|----------|----------|-------|-----------|-----------|------------|------------|-----------|
| | | SR180-PE1 | SR180-PE2 | SR180-PE3 | SR180-PE4 | SR41-PE6 | SR41-PE7 | SR41-PE8 | 6-06 | SR99-PE11 | SR99-PE12 | SR180-PE14 | SR180-PE15 | SR41-PE16 |
| 2001-01 | Note 4 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| 2001-02 | 9.1 | 52231 | 57607 | 15362 | 31492 | 8559 | 27651 | 26335 | 5944 | 8915 | 16048 | 46726 | 8961 | 8915 |
| 2001-03 | 25.1 | 143634 | 158420 | 42245 | 86603 | 23537 | 76042 | 72420 | 16345 | 24517 | 44131 | 128496 | 24643 | 24517 |
| 2001-04 | 3.3 | 18861 | 20803 | 5547 | 11372 | 3091 | 9985 | 9510 | 2146 | 3219 | 5795 | 16873 | 3236 | 3219 |
| 2001-05 | 8.1 | 46427 | 51206 | 13655 | 27993 | 7608 | 24579 | 23409 | 5283 | 7925 | 14265 | 41534 | 7965 | 7925 |
| 2001-06 | 7.1 | 40624 | 44806 | 11948 | 24494 | 6657 | 21507 | 20483 | 4623 | 6934 | 12482 | 36342 | 6970 | 6934 |
| 2001-07 | 4.1 | 23214 | 25603 | 6828 | 13996 | 3804 | 12290 | 11704 | 2642 | 3962 | 7132 | 20767 | 3983 | 3962 |
| 2001-08 | 4.8 | 27566 | 30404 | 8108 | 16621 | 4517 | 14594 | 13899 | 3137 | 4705 | 8470 | 24661 | 4729 | 4705 |
| 2001-09 | Note 4 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |
| 2001-10 | 6.6 | 37722 | 41605 | 11095 | 22744 | 6181 | 19970 | 19020 | 4293 | 6439 | 11590 | 33746 | 6472 | 6439 |
| 2001-11 | 37.8 | 216176 | 238430 | 63581 | 130342 | 35424 | 114446 | 108996 | 24600 | 36900 | 66420 | 193393 | 37089 | 36900 |
| 2001-12 | 24.6 | 140732 | 155219 | 41392 | 84853 | 23061 | 74505 | 70957 | 16015 | 24022 | 43240 | 125900 | 24145 | 24022 |
| 2001-13 | 3.3 | 18861 | 20803 | 5547 | 11372 | 3091 | 9985 | 9510 | 2146 | 3219 | 5795 | 16873 | 3236 | 3219 |
| 2001-14 | 11.4 | 65288 | 72009 | 19202 | 39365 | 10698 | 34564 | 32918 | 7430 | 11144 | 20060 | 58407 | 11201 | 11144 |
| 2001-15 | 14.7 | 84149 | 92812 | 24750 | 50737 | 13789 | 44550 | 42428 | 9576 | 14364 | 25855 | 75281 | 14437 | 14364 |
| 2001-17 | 11.7 | 66739 | 73609 | 19629 | 40240 | 10936 | 38532 | 33650 | 7595 | 11392 | 20505 | 59705 | 11450 | 11392 |
| 2001-18 | 5.1 | 29017 | 32004 | 8534 | 17496 | 4755 | 15362 | 14630 | 3302 | 4953 | 8915 | 25959 | 4978 | 4953 |

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Table 2-2 (continued)

TOTAL ESTIMATED EVENT FLOW VOLUME FOR STORM EVENTS AT FRESNO MONITORING SITES⁽¹⁾

Notes

- 1 Runoff coefficients for PELMS monitoring stations were estimated based on storm event field observations, as-built map analysis, and rainfall versus runoff relationships (for stations SR180-PE2 and SR41-PE6).
- 2 Total event rain is based on the litter sample duration of the monitoring event.
- 3 Total flow (V) for all PELMS sites is based on the estimated site runoff coefficient (C), total rain of the litter sample duration (P), and site watershed area (A) where $V = P*C*A*10000 \text{ L/ha-mm}$. All Fresno monitoring sites use the rain totals from R180-PE2 for the runoff analysis.
- 4 All Stockton sites use on-site rain records to determine the total event rain except Event 2001-03, 06, and -07 which used NWS data (Stockton - 048558). All hydrographs in Appendix B display the Caltrans defined storm event as calculated by the Caltrans Hydrologic Utility. Hydrographs include the peak flow and peak rainfall intensity but may not include the total flow for the litter sample duration.
- 4 Storm event monitored in Stockton only. No rain was recorded in Fresno for this event..

Table 2-3
TOTAL ESTIMATED EVENT FLOW VOLUME FOR
STORM EVENTS AT STOCKTON SITES

| Location | | Stockton | |
|---------------------------------------------|-----------------------------------------|-----------------------------------------|---------|
| Site ID | | I5-PE9 | I5-PE10 |
| Area (ha) | | 0.41 | 0.22 |
| Estimated Runoff Coefficient ⁽¹⁾ | | 0.7 | 0.7 |
| Event ID | Stockton Event Rain ⁽²⁾ (mm) | Total Estimated Flow ⁽³⁾ (L) | |
| 2001-01 | 4.3 | 12393 | 6650 |
| 2001-02 | 9.9 | 28430 | 15255 |
| 2001-03 | 20.6 | 59047 | 31684 |
| 2001-04 | 4.1 | 11664 | 6259 |
| 2001-05 | 16.8 | 48113 | 25817 |
| 2001-06 | 7.6 | 21869 | 11735 |
| 2001-07 | 24.9 | 71440 | 38334 |
| 2001-08 | 2.8 | 8019 | 4303 |
| 2001-09 | 2.0 | 5832 | 3129 |
| 2001-10 | 23.6 | 67795 | 36378 |
| 2001-11 | 110.0 | 315648 | 169372 |
| 2001-12 | Note 5 | --- | --- |
| 2001-13 | 7.1 | 20411 | 10952 |
| 2001-14 | 13.0 | 37178 | 19949 |
| 2001-15 | 19.1 | 54674 | 29337 |
| 2001-16 | 8.4 | 24056 | 12908 |
| 2001-17 | 18.8 | 53945 | 28946 |
| 2001-18 | 1.5 | 4374 | 2347 |

Notes

- 1 Runoff coefficients for PELMS monitoring stations were estimated based on storm event field observations and as-built map analysis.
- 2 Total event rain is based on the litter sample duration of the monitoring event.
- 3 Total flow (V) for all PELMS sites is based on the estimated site runoff coefficient (C), total rain of the litter sample duration (P), and site watershed area (A) where $V = P \cdot C \cdot A \cdot 10000 \text{ L/ha-mm}$.
All Stockton sites use on-site rain records to determine the total event rain except Event 2001-03, 06, and -07 which used NWS data (Stockton - 048558).
- 4 Stockton Event 2001-11 includes the rainfall for the period 12/27/01 to 1/3/02. A separate Event 2001-12 was not monitored in Stockton.

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Table 2-4
TOTAL MONTHLY AND SEASONAL RAINFALL (2001-2002)

| Station | 2001 | | | | 2002 | | | | Rainfall (mm.) | |
|----------------------------------------------------------------------------------------------------------------|-----------|---------|----------|----------|---------|----------|-------|-------|----------------|--|
| | September | October | November | December | January | February | March | April | | |
| Fresno Sites - (NWS - Fresno Yosemite International Airport (FAT), is approximately 5 miles northeast.) | | | | | | | | | | |
| PELMS - FRESNO | 0.0 | 9.1 | 54.4 | 52.6 | 23.9 | 11.9 | 32.5 | 5.3 | | |
| NWS - (FAT) | 0.0 | 7.4 | 50.5 | 49.5 | 19.3 | 10.7 | 24.1 | 5.3 | | |
| Fresno Historic Average (1) | 5.3 | 15.5 | 26.7 | 38.9 | 48.5 | 44.5 | 45.2 | 24.9 | | |
| Stockton Sites - (NWS - Stockton Fire Station #4 (STK), is approximately 2 miles northwest.) | | | | | | | | | | |
| PELMS-STOCKTON | 4.3 | 10.2 | 49.3 | 135.9 | 38.6 | 20.3 | 46.2 | 1.5 | | |
| NWS - (STK) | 5.1 | 7.1 | 50.3 | 126.7 | 41.4 | 17.8 | 45.5 | 3.6 | | |
| Stockton Historic Average (2) | 2.6 | 16.2 | 39.2 | 56.2 | 63.6 | 47.5 | 44.5 | 27.6 | | |
| | | | | | | | | | | |

Notes

- 1 Historic monthly average rainfall totals in Fresno are based on NWS precipitation totals from 1878 to 2002 (<http://www.wrh.noaa.gov/Hanford/climo/fatmnyr.html>).
- 2 Historic monthly average rainfall totals in Stockton are based on NWS precipitation totals from 1948 to 2000 (NCDC data provided by Hydrodata Volume 9.0).

SECTION THREE

This section describes the analytical procedure for laboratory litter analysis and data management methods and presents both total seasonal and event storm water litter and gross pollutant data from the 2001-2002 monitoring period.

3.1 ANALYTICAL PROCEDURE AND DATA MANAGEMENT

Litter samples collected from all monitoring sites were transported to a subcontracted litter laboratory in Fresno for analysis. Sample components measured consisted of gross pollutants (that is, the total co-mingled litter and vegetation sample), as well as the vegetation and litter. The general method for sample quantification consisted of the following procedures:

- Measure the weight and volume of the total sample (gross pollutants).
- Separate litter from vegetation.
- Measure weight and volume of the litter portion.
- Measure weight and volume of the vegetation portion.
- Dispose of the vegetation.
- Place litter on a screen rack to air dry for at least 24 hours.
- Measure the weight and volume of the air-dried litter.
- Dispose of the litter.

Laboratory analysis procedures were performed in accordance with the Caltrans Standard Litter Laboratory Analysis Method for the 2001-2002 monitoring season as presented in the Caltrans Guidance for Monitoring Storm Water Litter (Caltrans Document Number CTSW-RT-00-025) and PELMS SAP (Caltrans 2001, 2001a). Laboratory QA/QC was performed in accordance with this method.

All storm water gross pollutant litter and vegetation data were entered into a Microsoft Excel spreadsheet (spreadsheet) and managed in a Microsoft Access 97 database (database) in accordance with Caltrans 2001-2002 Litter Data-Reporting Protocols (August 2001). During litter analysis, measurements for each sample were recorded on a laboratory datasheet. All data were entered into two separate spreadsheets for quality assurance. These two spreadsheets were compared using an equation in Excel, after double data entry, to locate inconsistencies between all duplicate records. To determine the accurate value, all inconsistencies were compared against hard copy data sheets and revised. Additionally, data were reviewed in conjunction with field data reports and litter sample photographs to identify any data anomalies. The vegetation and litter portions of a given sample were summed and compared to the measurement of the total sample as an additional quality assurance check. Data were then copied into and managed in the database. Database queries were designed to extract information needed for data analysis.

3.2 SEASONAL GROSS POLLUTANT AND LITTER LOADS

Table 3-1 presents seasonal gross pollutant and air-dried litter loads measured during the 2000-2001 and 2001-2002 monitoring periods. Table 3-1 also lists the catchment area for each sampling site, which ranges from 0.10 to 1.07 hectares. One method of comparing gross pollutant or litter loads between sites is to normalize loads by catchment area and present loads at each sampling site in terms of load per hectare. Normalized seasonal litter and gross pollutant loads are presented in Table 3-2.

SECTION THREE

Preliminary Litter and Gross Pollutant Litter Data

Table 3-1
SEASONAL AIR-DRIED LITTER AND GROSS POLLUTANTS
BY WEIGHT AND VOLUME

| Site | Area (Hectares) | 2000-2001 Storm Season | | | | | | 2001-2002 Storm Season | | | | | |
|---------------------------|--------------------|------------------------|-------------|------------|------------------|-------------|------------|------------------------|-------------|------------|------------------|-------------|------------|
| | | Air-Dried Litter | | | Gross Pollutants | | | Air-Dried Litter | | | Gross Pollutants | | |
| | | Total | Weight (Kg) | Volume (L) | Total | Weight (Kg) | Volume (L) | Total | Weight (Kg) | Volume (L) | Total | Weight (Kg) | Volume (L) |
| SR180-PE1 | 0.68 | 1.1 | 24.6 | 44.7 | 99.7 | 3.4 | 38.0 | 99.5 | | | 234.3 | | |
| SR180-PE2 | 0.75 | 0.6 | 13.4 | 45.2 | 64.7 | 1.9 | 26.6 | 74.2 | | | 178.4 | | |
| SR180-PE3 | 0.20 | 0.5 | 11.7 | 31.3 | 78.6 | 2.1 | 24.1 | 75.9 | | | 184.0 | | |
| SR180-PE4 | 0.41 | 0.7 | 16.4 | 21.7 | 78.0 | 2.1 | 45.5 | 48.9 | | | 236.6 | | |
| SR41-PE6 | 0.13 | 0.1 | 1.6 | 3.7 | 14.3 | 0.2 | 4.0 | 10.1 | | | 22.9 | | |
| SR41-PE7 | 0.42 | 0.3 | 6.4 | 19.8 | 54.4 | 0.7 | 11.1 | 17.4 | | | 87.7 | | |
| SR41-PE8 | 0.41 | 0.3 | 7.6 | 5.4 | 33.4 | 0.4 | 4.9 | 8.6 | | | 39.9 | | |
| SR41-PE16 ⁽¹⁾ | 0.15 | 0.1 | 1.8 | 5.6 | 10.0 | 0.4 | 6.1 | 8.9 | | | 50.7 | | |
| SR99-6-06 ⁽¹⁾ | 0.10 | 0.2 | 1.4 | 3.8 | 11.7 | 0.1 | 3.4 | 4.0 | | | 9.0 | | |
| SR99-PE11 ⁽¹⁾ | 0.15 | 0.1 | 0.6 | 2.5 | 6.9 | 0.5 | 4.2 | 8.0 | | | 31.0 | | |
| SR99-PE12 ⁽¹⁾ | 0.15 | 0.2 | 4.4 | 2.2 | 18.4 | 1.1 | 30.4 | 6.4 | | | 69.6 | | |
| SR99-PE13 ⁽¹⁾ | 0.27 | 0.1 | 1.7 | 2.3 | 12.8 | 0.8 | 16.3 | 12.1 | | | 45.6 | | |
| SR180-PE14 ⁽¹⁾ | 1.07 | 1.9 | 34.9 | 51.4 | 112.3 | 9.0 | 91.2 | 204.7 | | | 506.8 | | |
| SR180-PE15 ⁽¹⁾ | 0.27 | 0.8 | 20.5 | 4.0 | 49.6 | 1.5 | 76.2 | 11.8 | | | 158.9 | | |
| 15-PE9 | 0.41 | 1.1 | 23.1 | 74.6 | 170.6 | 3.5 | 43.5 | 129.8 | | | 401.5 | | |
| 15-PE10 | 0.22 | 1.9 | 35.8 | 144.8 | 167.5 | 3.0 | 40.9 | 108.7 | | | 336.0 | | |

(1) Sites SR99-6-06, SR99-PE11, SR99-PE12, SR99-PE13, SR180-PE14, SR180-PE15, and SR41-PE16 were installed part way through the 2000-2001 storm season. Therefore, totals do not represent all storms during the 2000-2001 monitoring period.

SECTION THREE

Preliminary Litter and Gross Pollutant Litter Data

Table 3-2
**SEASONAL AIR-DRIED LITTER AND GROSS POLLUTANTS
 BY WEIGHT AND VOLUME, NORMALIZED BY AREA**

| Site | Area (Hectares) | 2000-2001 Storm Season | | | | 2001-2002 Storm Season | | | |
|---------------------------|--------------------|------------------------|-------------------------|------------------------|------------------|------------------------|-------------------------|------------------------|------------------|
| | | Air-Dried Litter | Total Weight (Kg/Ha) | Total Volume (L/Ha) | Gross Pollutants | Air-Dried Litter | Total Weight (Kg/Ha) | Total Volume (L/Ha) | Gross Pollutants |
| SR180-PE1 | 0.68 | 1.6 | 36.2 | 65.8 | 146.6 | 5.0 | 55.9 | 146.3 | 344.5 |
| SR180-PE2 | 0.75 | 0.8 | 17.8 | 60.2 | 86.3 | 2.5 | 35.5 | 99.0 | 237.9 |
| SR180-PE3 | 0.20 | 2.6 | 58.4 | 156.5 | 392.8 | 10.3 | 120.3 | 379.7 | 919.8 |
| SR180-PE4 | 0.41 | 1.6 | 40.0 | 53.0 | 190.2 | 5.2 | 111.0 | 119.2 | 577.1 |
| SR41-PE6 | 0.13 | 0.8 | 11.9 | 28.7 | 109.8 | 1.8 | 31.1 | 78.0 | 175.8 |
| SR41-PE7 | 0.42 | 0.8 | 15.1 | 47.1 | 129.5 | 1.7 | 26.5 | 41.3 | 208.7 |
| SR41-PE8 | 0.41 | 0.7 | 18.4 | 13.3 | 81.4 | 0.9 | 12.0 | 21.1 | 97.2 |
| SR41-PE16 ⁽¹⁾ | 0.15 | 0.4 | 11.9 | 37.5 | 66.7 | 2.8 | 40.4 | 59.5 | 338.0 |
| SR99-6-06 ⁽¹⁾ | 0.10 | 1.7 | 14.0 | 38.4 | 117.3 | 0.9 | 34.0 | 39.9 | 90.2 |
| SR99-PE11 ⁽¹⁾ | 0.15 | 0.6 | 4.2 | 16.5 | 46.2 | 3.0 | 28.2 | 53.5 | 206.3 |
| SR99-PE12 ⁽¹⁾ | 0.15 | 1.1 | 29.1 | 14.5 | 122.4 | 7.3 | 202.3 | 42.4 | 463.8 |
| SR99-PE13 ⁽¹⁾ | 0.27 | 0.3 | 6.2 | 8.4 | 47.6 | 3.0 | 60.3 | 45.0 | 168.9 |
| SR180-PE14 ⁽¹⁾ | 1.07 | 1.8 | 32.6 | 48.0 | 105.0 | 8.4 | 85.2 | 191.3 | 473.6 |
| SR180-PE15 ⁽¹⁾ | 0.27 | 2.9 | 75.8 | 14.6 | 183.7 | 5.5 | 282.3 | 43.7 | 588.5 |
| I5-PE9 | 0.41 | 2.8 | 56.4 | 181.9 | 416.0 | 8.6 | 106.2 | 316.5 | 979.3 |
| I5-PE10 | 0.22 | 8.8 | 162.5 | 658.2 | 761.5 | 13.6 | 185.8 | 494.2 | 1527.0 |

(1) Sites SR99-6-06, SR99-PE11, SR99-PE12, SR99-PE13, SR99-PE14, SR180-PE14, SR180-PE15, and SR41-PE16 were installed part way through the 2000-2001 storm season. Therefore, totals do not represent all storms during the 2000-2001 monitoring period.

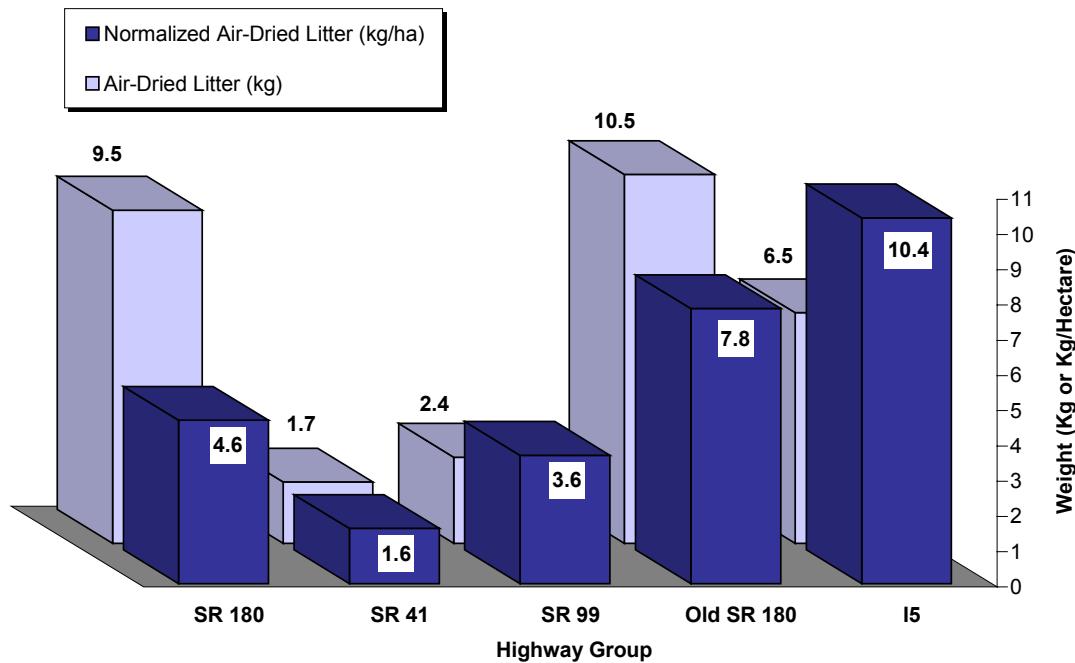
Tables 3-1 and 3-2 list sites that have been categorized based on the five highway groups. The first four (SR 99, SR 180, SR 41, and Old SR 180) are in Fresno. The fifth, I5, is in Stockton. Tables 3-1 and 3-2 provide a comparison of 2000-2001 and 2001-2002 storm season total gross pollutant and litter collection. All highway groups show a trend of increased gross pollutant and litter collection in the 2001-2002 storm season. Table 3-2 shows that for the 2001-2002 storm season, the greatest amount of normalized air dried litter weight was collected at site I5-PE10 (13.6 kilograms/hectare), while the lowest amount collected was at sites SR41-PE8 and SR99-6-06 (0.9 kilograms/hectare). The greatest amount of normalized litter volume was collected at site SR180-PE15 (282.3 liters/hectare), while the lowest amount collected was at site SR41-PE8 (12.0 liters/hectare). The greatest amount of normalized gross pollutant weight was collected at site I5-PE10 (494.2 kilograms/hectare), while the lowest amount collected was at site SR41-PE8 (21.1 kilograms/hectare). The greatest amount of normalized gross pollutant volume was collected at site I5-PE10 (1527.0 liters/hectare), while the lowest amount collected was at site SR99-6-06 (90.2 liters/hectare).

Figures 3-1 and 3-2 present both the normalized and non-normalized seasonal litter loads for each monitoring group by weight and volume, respectively. Weights and volumes of individual monitoring sites were summed according to highway (that is, SR 99, SR 180, Old SR 180, SR 41, and I5) and divided by the sum of the catchment areas monitored in each group. Review of Figures 3-1 and 3-2 allows a comparison of relative litter loads for each highway group. Figures 3-1 and 3-2 show that the highest normalized seasonal litter load (134.0 liters/10.4 kilograms of litter per hectare) was collected at the I5 group in Stockton. The figures also show that the lowest normalized seasonal litter load (23.5 liters/1.6 kilograms of litter per hectare) was collected at the SR 41 highway group in Fresno.

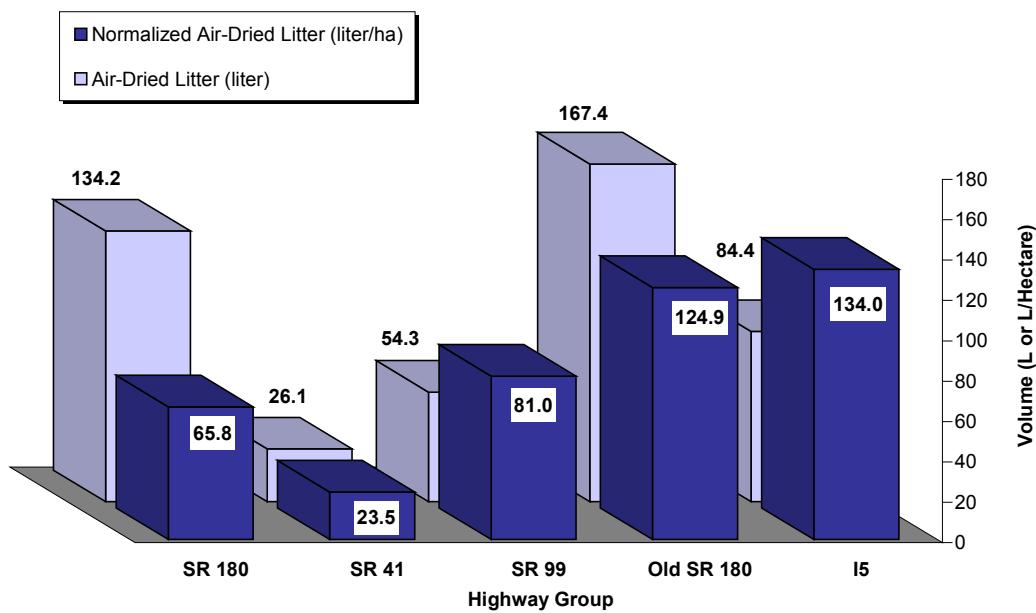
3.3 PERCENT LITTER IN GROSS POLLUTANT LOADS

The first steps in the litter analysis process were to measure the total material retained by the monitoring nets (gross pollutants), separate litter from vegetation, and measure the vegetation and litter portions. These measurements can then be used to calculate the percentage of litter in the gross pollutant loads. Table 3-3 presents the total percent litter of gross pollutants collected for the five monitoring groups (SR 41, SR 180, I5, SR 99, and Old SR 180) for both the 2000-2001 and the 2001-2002 seasons. The percent litter was calculated on a wet basis (that is, total wet litter/total wet gross pollutants). For the 2001-2002 season, the percent litter by volume for highway groups ranged from 11.1 percent for SR 41 to 33.4 percent for SR 99. The percent litter by weight for highway groups ranged from 4.8 percent for I5 (Stockton) to 10.5 percent for SR 99. Percentages for the two sites on old SR180 are presented individually for the two sites. SR180-PE14 shows a similar breakdown compared to the highway sites. SR180-PE15 has a higher percentage of litter for both seasons than other sites, which may be due to fewer trees and sources for vegetation in the area. These percentages are comparable to percentages from the 2000-2001 season indicating that the relative breakdown of litter and vegetation in the gross pollutants is similar for both years.

**Figure 3-1
TOTAL SEASONAL AIR-DRIED LITTER WEIGHT GROUPED BY HIGHWAY**



**Figure 3-2
TOTAL SEASONAL AIR-DRIED LITTER VOLUME GROUPED BY HIGHWAY**



**Table 3-3
PERCENT LITTER IN GROSS POLLUTANTS PER HIGHWAY GROUP**

| Site | 2000-2001 Storm Season | | 2001-2002 Storm Season | |
|--------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|-----------------------------------------|
| | Percent Litter by Weight ⁽¹⁾ | Percent Litter by Volume ⁽²⁾ | Percent Litter by Weight ⁽¹⁾ | Percent Litter by Volume ⁽²⁾ |
| SR 180 | 4.6% | 15.0% | 5.8% | 13.1% |
| SR 41 ⁽³⁾ | 4.6% | 10.3% | 9.1% | 11.1% |
| SR 99 | 7.1% | 13.5% | 10.5% | 33.4% |
| I5 | 3.0% | 12.6% | 4.8% | 18.2% |
| Old SR 180-PE14 ⁽⁴⁾ | 7.9% | 21.5% | 8.8% | 14.9% |
| Old SR 180-PE15 ⁽⁴⁾ | 31.7% | 39.3% | 18.0% | 43.8% |

NOTES:

- (1) Calculated as the total weight of wet litter divided by the total weight of wet gross pollutants and then multiplied by 100.
- (2) Calculated as the total volume of wet litter divided by the total volume of wet gross pollutants and then multiplied by 100.
- (3) 2000-2001 SR41 values include data from site SR41-PE5. This site experienced repeated flooding problems and was decommissioned on 3/16/01 and replaced by SR41-PE16, installed on 3/19/01.
- (4) Average percentage was not calculated for Old SR 180 combined sites (PE14 and PE15), because of the difference between individual site percentages for both storm seasons.

3.4 EVENT LITTER DATA

Tables 3-4 and 3-5 present the event litter data at each of the outfalls for litter air-dried weight and volume, respectively. Both tables include data for litter collected after monitored storm events and during pre-storm setup (that is, from nuisance flows or non-trigger events that occurred since the last monitored event). Monitored event IDs are characterized by the beginning year of the storm season followed by a dash and a numerical value (for example, "2001-02"). Pre-storm setup sample IDs are characterized with an "i" instead of a dash between the year and numerical value (for example, "2001i01"). During the 2001-2002 monitoring season, samples were collected for 17 storm events and 10 pre-storm periods. The monitored litter data for each outfall presented in the tables have not been normalized by catchment areas or flow volumes. Catchment areas for each outfall are, however, presented in Tables 3-1 and 3-2. For an explanation of the rainfall and flow totals associated with each event, refer to Section 2.

Figures 3-3 through 3-6 illustrate the cumulative air-dried litter quantities (volume and weight) collected at each of the 16 monitoring sites and facilitate visual comparison of constituent amounts at each site over the 2001-2002 monitoring season. For most sites, the plots show a trend of gradual increase over the storm season, as expected. Figures 3-3 and 3-4, respectively, illustrate the non-normalized cumulative air-dried litter weights and volumes. Figures 3-3 and 3-4 show the largest rate of increase in cumulative litter weight and volume over the season for highway groups I5 and Old SR 180. To allow relative comparisons between sites, litter data from each outfall were normalized by catchment area (that is, data presented in weight and

SECTION THREE

Preliminary Litter and Gross Pollutant Litter Data

Table 3-4
LITTER AIR-DRYED WEIGHT (g)

| Site Name | Preseason ⁽²⁾ | Storm Event>Date ⁽¹⁾ | | | | | | | | | | 2001-11-11 12/27/01 |
|---------------------|--------------------------|---------------------------------|------------------------------------|------------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------------------------------|------------------------------------|------------------------|
| | | 2001-01-01 9/25/01 | 2001-02 11/10/01 ⁽³⁾ | 2001-03 11/12/01 ⁽⁴⁾ | 2001-04 11/21/01 | 2001-05 11/23/01 | 2001-06 11/25/01 | 2001-07 12/01/01 | 2001-08 12/13/01 | 2001-09 ⁽⁵⁾ 12/17/01 | 2001-10 ⁽⁶⁾ 12/21/01 | |
| SR180-PE1 | 73 | 0 | 65 | 19 | 799 | 0 | 232 | 23 | 29 | 0 | 0 | 25 |
| SR180-PE2 | 68 | 0 | 138 | 517 | 207 | 0 | 12 | 50 | 12 | 0 | 0 | 33 |
| SR180-PE3 | 66 | 0 | 157 | 62 | 194 | 0 | 111 | 11 | 44 | 0 | 0 | 15 |
| SR180-PE4 | 294 | 0 | 374 | 58 | 168 | 0 | 37 | 16 | 22 | 2 | 0 | 53 |
| SR41-PE6 | 7 | 0 | 20 | 25 | 17 | 0 | 6 | 14 | 1 | 0 | 0 | 1 |
| SR41-PE7 | 7 | 0 | 163 | 47 | 19 | 0 | 8 | 4 | 12 | 0 | 0 | 16 |
| SR41-PE8 | 15 | 0 | 39 | 20 | 44 | 0 | 4 | 8 | 1 | 0 | 0 | 2 |
| SR41-PE16 | 43 | 0 | 74 | 12 | 23 | 0 | 11 | 10 | 16 | 0 | 0 | 3 |
| SR99-6-06 | 4 | 0 | 46 | 0 | 10 | 0 | 4 | 8 | 2 | 0 | 0 | 2 |
| SR99-PE11 | 46 | 0 | 23 | 0 | 58 | 0 | 0 | 71 | 1 | 90 | 0 | 4 |
| SR99-PE12 | 454 | 0 | 24 | 12 | 190 | 0 | 12 | 20 | 1 | 1 | 23 | 6 |
| SR99-PE13 | 79 | 14 | 9 | 4 | 352 | 0 | 6 | 28 | 8 | 2 | 7 | 1 |
| SR180-PE14 | 4855 | 602 | 202 | 405 | 158 | 130 | 24 | 172 | 18 | 23 | 125 | 21 |
| SR180-PE15 | 411 | 301 | 16 | 54 | 68 | 37 | 10 | 10 | 15 | 15 | 0 | 8 |
| I5-PE9 | 29 | 92 | 0 | 136 | 6 | 1720 | 70 | 0 | 185 | 33 | 142 | 0 |
| I5-PE10 | 37 | 145 | 0 | 369 | 0 | 111 | 4 | 0 | 1259 | 7 | 102 | 0 |
| Event Totals | 6487 | 237 | 917 | 1856 | 1240 | 4135 | 241 | 477 | 1889 | 222 | 377 | 155 |
| | | | | | | | | | | | | 287 |
| | | | | | | | | | | | | 12 |
| | | | | | | | | | | | | 240 |
| | | | | | | | | | | | | 860 |

(1) Date when associated pre- or post-storm procedures were conducted.

(2) Preseason Litter Weight is the sum of preseason litter collection event totals and pre-storm 2000-01 litter collection event totals.

(3) Event 2001-02 was a non-event in Fresno.

(4) Post-event procedures were performed on 10/31/01 in Stockton.

(5) Pre-event litter was collected twice at sites S180-PE14 and S180-PE15 on 11/10/01 and 11/12/01.

(6) Event 2001-09 was a non-event in Fresno.

(7) Shaded cells represent samples not collected during post-event procedures, due to the early onset of Event 2001-11. The litter bag at Site PE1 was stolen and therefore a sample was not collected.

(8) Post-event procedures for Event 2001-11 were conducted on 1/3/02 in Stockton and 12/31/01 in Fresno.

SECTION THREE

Preliminary Litter and Gross Pollutant Litter Data

Table 3-4 (continued)
LITTER AIR-DRYED WEIGHT (g)

| Site Name | Storm Event/Date | | | | | | | | | | Post-Season 57/02 4/18/02 | Seasonal Total (kg) per Site | | | |
|---------------------|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|-----------------------|-----------------------|---------------------------------|------------------------------------|------------|-----|------|
| | 2001-12/02 1/4/02 | 2001-12/02 1/25/02 | 2001-13/02 1/29/02 | 2001-14/02 2/15/02 | 2001-14/02 2/18/02 | 2001-15/02 3/5/02 | 2001-16/02 3/12/02 | 2001-16/02 3/22/02 | 2001-17/02 3/21/02 | 2001-17/02 3/25/02 | | | | | |
| SR180-PE1 | 205 | 0 | 26 | 0 | 936 | 0 | 101 | | | | 65 | 277 | 197 | 35 | 3.40 |
| SR180-PE2 | 151 | 0 | 4 | 0 | 339 | 0 | 86 | | | | 44 | 114 | 47 | 0 | 1.87 |
| SR180-PE3 | 32 | 0 | 3 | 0 | 710 | 0 | 131 | | | | 0 | 328 | 80 | 51 | 2.06 |
| SR180-PE4 | 41 | 0 | 0 | 0 | 327 | 0 | 239 | | | | 29 | 231 | 164 | 0 | 2.12 |
| SR41-PE6 | 4 | 0 | 0 | 0 | 54 | 0 | 41 | | | | 0 | 26 | 15 | 0 | 0.24 |
| SR41-PE7 | 47 | 0 | 2 | 0 | 62 | 0 | 93 | | | | 0 | 139 | 0 | 55 | 0.71 |
| SR41-PE8 | 20 | 0 | 1 | 0 | 92 | 0 | 25 | | | | 0 | 46 | 7 | 0 | 0.36 |
| SR41-PE16 | 35 | 0 | 1 | 0 | 64 | 0 | 20 | | | | 0 | 74 | 21 | 0 | 0.42 |
| SR99-6-06 | 0 | 0 | 3 | 0 | 1 | 0 | 4 | | | | 0 | 8 | 0 | 0 | 0.09 |
| SR99-PE11 | 4 | 0 | 0 | 0 | 10 | 0 | 34 | | | | 0 | 62 | 0 | 24 | 0.45 |
| SR99-PE12 | 24 | 30 | 3 | 0 | 46 | 12 | 14 | | | | 18 | 55 | 0 | 108 | 1.09 |
| SR99-PE13 | 7 | 11 | 4 | 9 | 4 | 0 | 22 | | | | 0 | 108 | 0 | 97 | 0.81 |
| SR180-PE14 | 152 | 217 | 23 | 117 | 33 | 198 | 94 | | | | 192 | 150 | 502 | 465 | 8.99 |
| SR180-PE15 | 6 | 81 | 4 | 18 | 2 | 53 | 95 | | | | 34 | 19 | 122 | 66 | 1.47 |
| 15-PE9 | 9 | 30 | 176 | 152 | 0 | 296 | 24 | 107 | | | 92 | 22 | 4 | 4 | 3.55 |
| 15-PE10 | 42 | 38 | 50 | 110 | 0 | 311 | 13 | 57 | | | 168 | 6 | 0 | 0 | 3.00 |
| Event Totals | 728 | 390 | 142 | 370 | 2942 | 263 | 1606 | 37 | 164 | 382 | 1897 | 1183 | 905 | | |

(9) In Fresno, Event 2001-11 ended on December 31, and Event 2001-12 began on January 2. In Stockton, Event 2001-11 lasted from December 28 through January 2 with no discernable break in rainfall. Consequently, a separate Event 2001-12 did not occur in Stockton.

(10) Event 2001-16 was an event in Stockton only

(11) Pre-storm setup was not conducted, because of low QPF. Actual rain was greater than predicted. Consequently, post-storm procedures were conducted.

SECTION THREE

Preliminary Litter and Gross Pollutant Litter Data

Table 3-5
LITTER AIR-DRIED VOLUME (mL)

| Site Name | Preseason 9/25/01 2001-01(3) | Storm Event/Date(1) | | | | | | | | | |
|---------------------|------------------------------------|-----------------------|------------------------|------------------------|---------------------|---------------------|--------------------|---------------------|------------------------|---------------------|------------------------|
| | | 2001-02 11/1/01(4) | 2001-03 11/12/01(5) | 2001-04 11/21/01(6) | 2001-05 11/23/01 | 2001-06 11/30/01 | 2001-07 12/3/01 | 2001-08 12/17/01 | 2001-09 12/19/01(6) | 2001-10 12/27/01 | 2001-11 12/31/01(6) |
| SR180-PE1 | 1500 | 0 | 2000 | 200 | 7000 | 0 | 3000 | 425 | 250 | 0 | 500 |
| SR180-PE2 | 4000 | 0 | 3500 | 5000 | 1000 | 0 | 200 | 250 | 225 | 0 | 1200 |
| SR180-PE3 | 1000 | 0 | 4000 | 1500 | 1000 | 0 | 1000 | 250 | 1500 | 0 | 0 |
| SR180-PE4 | 8500 | 0 | 13000 | 2000 | 2000 | 0 | 600 | 500 | 375 | 30 | 0 |
| SR41-PE6 | 75 | 0 | 400 | 250 | 250 | 0 | 50 | 1300 | 0 | 0 | 3 |
| SR41-PE7 | 200 | 0 | 4000 | 1000 | 200 | 0 | 200 | 100 | 125 | 0 | 0 |
| SR41-PE8 | 200 | 0 | 300 | 300 | 800 | 0 | 100 | 0 | 0 | 0 | 5 |
| SR41-PE16 | 1000 | 0 | 2000 | 150 | 200 | 0 | 100 | 125 | 25 | 0 | 100 |
| SR99-PE6 | 75 | 0 | 1500 | 5 | 50 | 0 | 1500 | 25 | 25 | 0 | 75 |
| SR99-PE11 | 2550 | 0 | 100 | 1 | 150 | 0 | 1 | 200 | 50 | 200 | 0 |
| SR99-PE12 | 17650 | 0 | 300 | 350 | 1200 | 0 | 375 | 375 | 10 | 15 | 800 |
| SR99-PE13 | 3550 | 1000 | 125 | 50 | 500 | 0 | 3000 | 300 | 200 | 200 | 150 |
| SR180-PE14 | 27000 | 7500 | 4000 | 9000 | 4000 | 1500 | 1000 | 5000 | 700 | 400 | 2000 |
| SR180-PE15 | 34500 | 7500 | 150 | 2200 | 300 | 3500 | 2500 | 500 | 800 | 2500 | 0 |
| 15-PE9 | 3500 | 3000 | 0 | 3000 | 75 | 8000 | 1000 | 0 | 2000 | 500 | 2500 |
| 15-PE10 | 2500 | 6000 | 0 | 7000 | 50 | 1500 | 100 | 0 | 7500 | 50 | 1500 |
| Event Totals | 107800 | 9000 | 16000 | 45375 | 22131 | 28150 | 6100 | 13626 | 18950 | 4835 | 7345 |
| | | | | | | | | | | | 9983 |
| | | | | | | | | | | | 350 |
| | | | | | | | | | | | 4325 |
| | | | | | | | | | | | 17925 |

(1) Date when associated pre- or post-storm procedures were conducted.

(2) Preseason Litter Weight is the sum of preseason litter collection event totals and pre-storm 2000-01 litter collection event totals.

(3) Event 2001-02 was a non-event in Fresno.

(4) Post-event procedures were performed on 10/31/01 in Stockton.

(5) Pre-event litter was collected twice at sites S180-PE14 and S180-PE15 on 11/1/00 and 11/12/01.

(6) Event 2001-09 was a non-event in Fresno.

(7) Shaded cells represent samples not collected during post-event procedures, due to the early onset of Event 2001-11. The litter bag at Site PE1 was stolen and therefore a sample was not collected.

(8) Postevent procedures for Event 2001-11 were conducted on 11/3/02 in Stockton and 12/31/01 in Fresno.

SECTION THREE

Preliminary Litter and Gross Pollutant Litter Data

Table 3-5 (continued)
LITTER AIR-DRIED VOLUME (mL)

| Site Name | Storm Event/Date | | | | | | | | | | Post-Season 5/7/02 (L) per site Seasonal Vol |
|--------------------|-----------------------|--------------------|--------------------|--------------------|-------------------|-------------------|--------------------|--------------------|--------------------|----------------------------|-------------------------------------------------------|
| | 2001-12/02 1/14/02 | 2001-13 1/25/02 | 2001-14 2/15/02 | 2001-14 2/18/02 | 2001-15 3/5/02 | 2001-15 3/8/02 | 2001-16 3/12/02 | 2001-16 3/21/02 | 2001-17 3/25/02 | 2001-18 4/18/02 (11) | |
| SR180-PE1 | 2500 | 0 | 150 | 0 | 6300 | 0 | 1500 | 0 | 600 | 2000 | 3500 |
| SR180-PE2 | 2000 | 0 | 25 | 0 | 4200 | 0 | 1300 | 0 | 400 | 1000 | 1000 |
| SR180-PE3 | 500 | 0 | 100 | 0 | 5000 | 0 | 2000 | 0 | 0 | 3000 | 1500 |
| SR180-PE4 | 1000 | 0 | 1 | 0 | 5500 | 0 | 2500 | 0 | 300 | 2000 | 2500 |
| SR41-PE6 | 40 | 0 | 3 | 0 | 700 | 0 | 250 | 0 | 0 | 400 | 200 |
| SR41-PE7 | 250 | 0 | 50 | 0 | 900 | 0 | 1200 | 0 | 0 | 1000 | 0 |
| SR41-PE8 | 250 | 0 | 1 | 0 | 1500 | 0 | 200 | 0 | 0 | 200 | 50 |
| SR41-PE16 | 350 | 0 | 5 | 0 | 700 | 0 | 150 | 0 | 0 | 500 | 400 |
| SR99-6-06 | 3 | 0 | 8 | 0 | 10 | 0 | 25 | 0 | 0 | 50 | 0 |
| SR99-PE11 | 25 | 1 | 0 | 0 | 50 | 0 | 200 | 0 | 0 | 125 | 0 |
| SR99-PE12 | 300 | 600 | 25 | 0 | 1200 | 100 | 300 | 0 | 800 | 250 | 0 |
| SR99-PE13 | 100 | 250 | 25 | 200 | 25 | 0 | 300 | 0 | 0 | 600 | 0 |
| SR180-PE14 | 2000 | 2000 | 450 | 2000 | 600 | 3000 | 1200 | 0 | 2500 | 1500 | 6000 |
| SR180-PE15 | 100 | 6000 | 200 | 2500 | 75 | 1500 | 1000 | 0 | 1000 | 600 | 4500 |
| 15-PE9 | 350 | 400 | 3500 | 3000 | 0 | 4000 | 300 | 1000 | 1500 | 1300 | 300 |
| 15-PE10 | 800 | 600 | 1000 | 2000 | 0 | 3000 | 100 | 800 | 2000 | 325 | 0 |
| Grand Total | 9418 | 10001 | 2043 | 9200 | 31760 | 4600 | 19125 | 400 | 7400 | 16725 | 21275 |
| | | | | | | | | | | | 19200 |

(9) In Fresno, Event 2001-11 ended on December 31, and Event 2001-12 began on January 2. In Stockton, Event 2001-11 lasted from December 28 through January 2 with no discernable break in rainfall. Consequently, a separate Event 2001-12 did not occur in Stockton.

(10) Event 2001-16 was an event in Stockton only.

(11) Pre-storm setup was not conducted, because of low QPF. Actual rain was greater than predicted. Consequently, post-storm procedures were conducted.

Figure 3-3
CUMULATIVE AIR-DRIED LITTER WEIGHT (Kg) 2001-2002

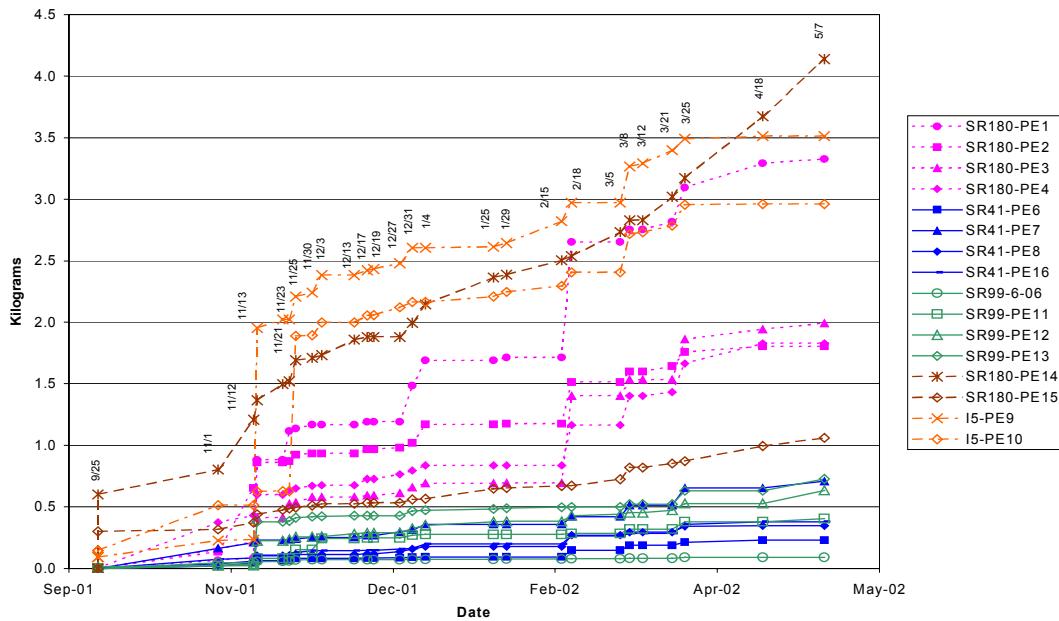
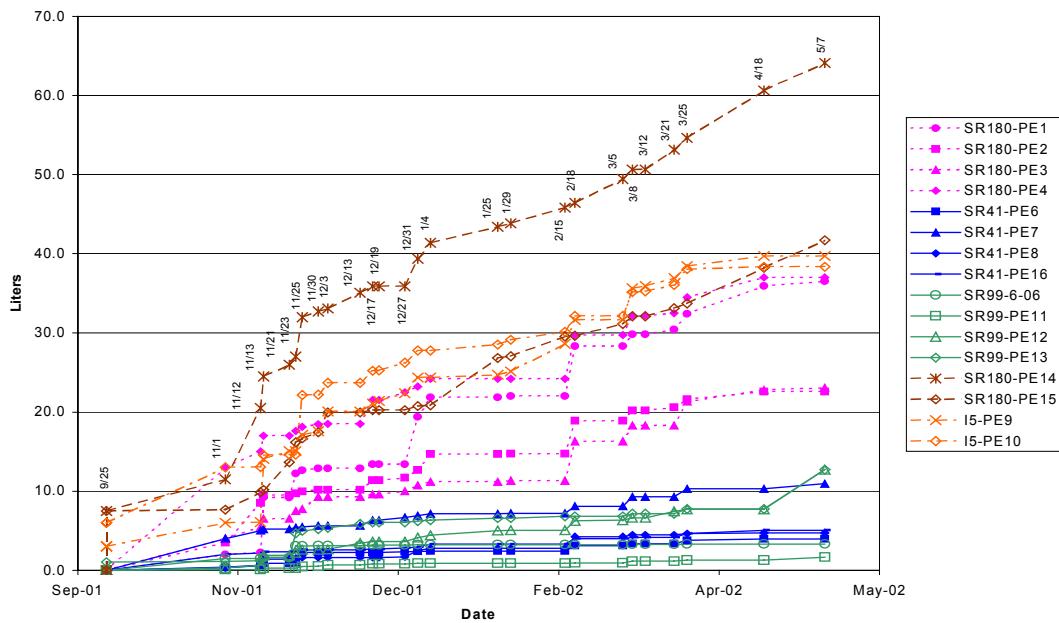
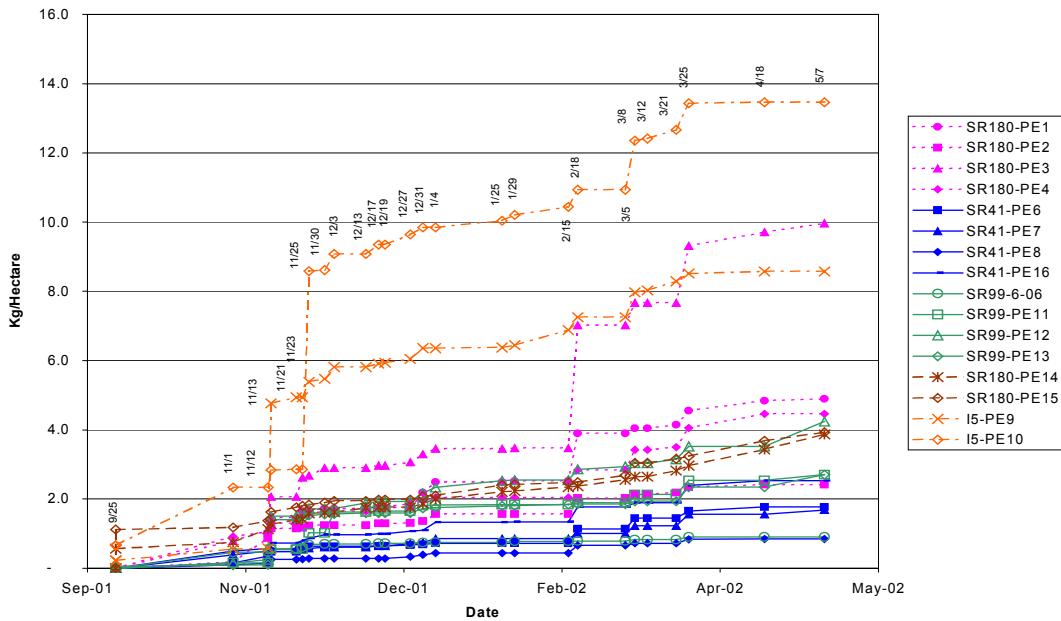


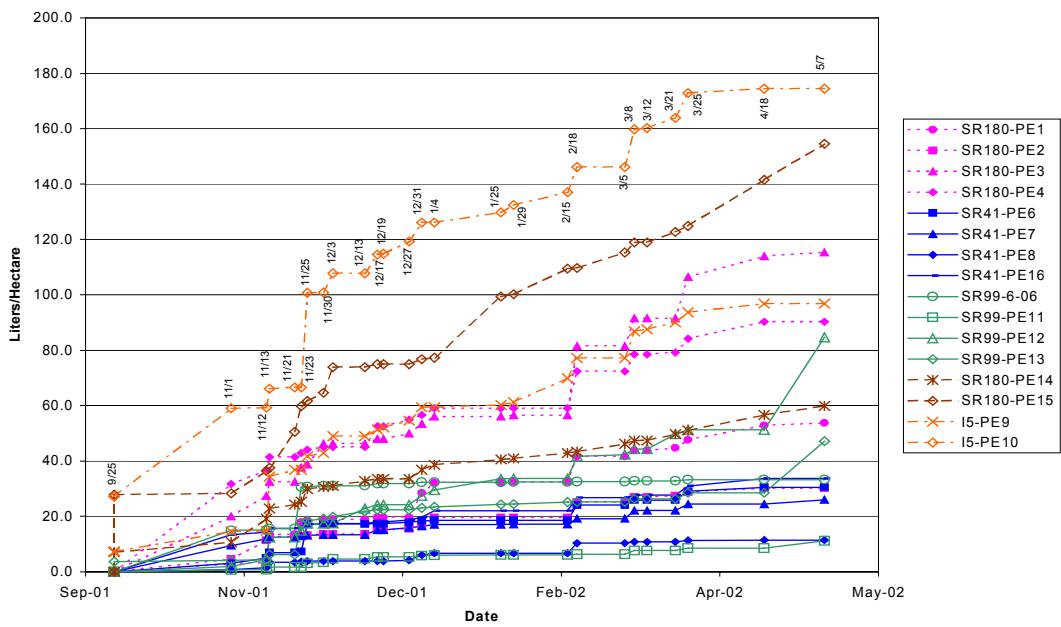
Figure 3-4
CUMULATIVE AIR-DRIED LITTER VOLUME (L) 2001-2002



**Figure 3-5
CUMULATIVE AIR-DRIED LITTER WEIGHT (Kg),
NORMALIZED BY AREA 2001-2002**



**Figure 3-6
CUMULATIVE AIR-DRIED LITTER VOLUME (L),
NORMALIZED BY AREA 2001-2002**



volume of litter collected divided by catchment area per hectare). Figures 3-5 and 3-6, respectively, illustrate air-dried litter weight and volume normalized by catchment area. The figures show the largest rate of increase in normalized cumulative litter weight and volume over the season for highway groups I5 and sites SR180-PE15 and SR180-PE3.

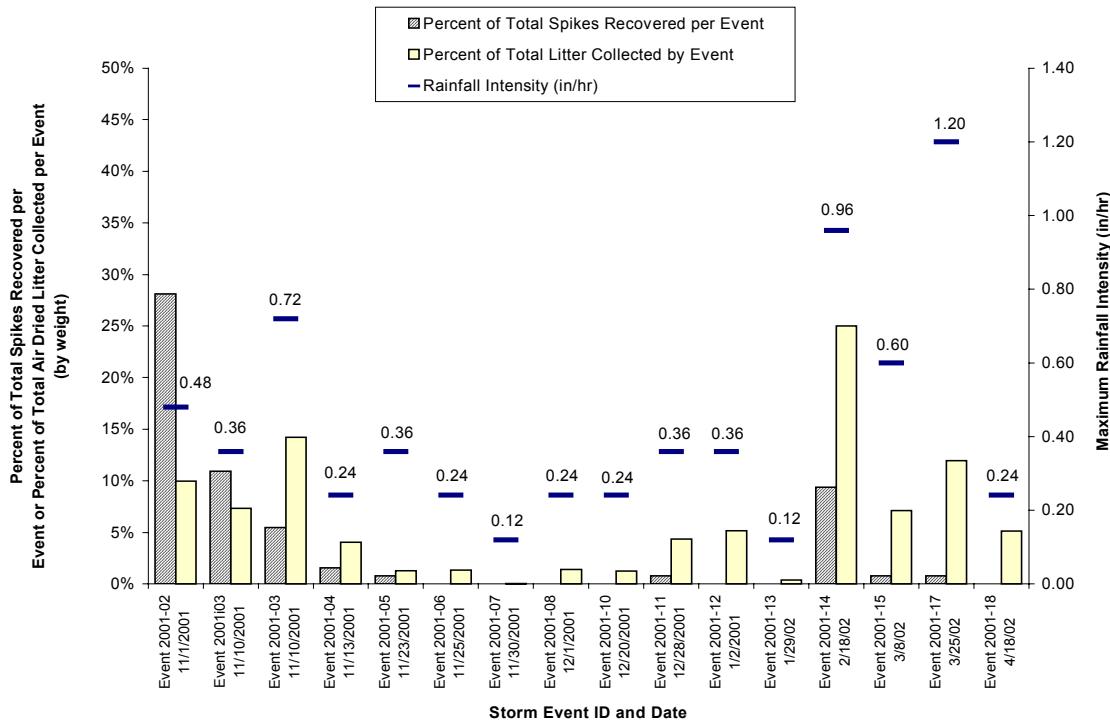
3.5 FIRST FLUSH MONITORING AND ASSESSMENT

This section presents the results from a first flush spike recovery analysis conducted in accordance with the PELMS 2001–2002 SAP, Addendum No. 1. Inlet spikes were placed at selected inlets along two highway groups, SR 180 and SR 41. The spikes placed were similar to the Litter Management Pilot Study (LMPS) spike items (that is, a marked plastic coffee cup lid piece, cigarette butts, gum wrappers, etc). Spikes were labeled differently for each inlet in a common drainage system. The four SR 180 sampling sites with spiked inlets included SR 180-PE1, SR 180-PE2, SR 180-PE3, and SR 180-PE4. The four SR 41 sampling sites with spiked inlets included SR 41-PE6, SR 41-PE7, SR 41-PE8, and SR 41-PE16. The purpose of the first flush analysis was to assess the transport of material that accumulated in the inlets prior to the rain season to drainage system outfalls, with the intention of identifying a litter “first flush”.

Figure 3-7 presents a comparison of maximum rainfall intensity per event (inches per hour) versus litter collection and spike recovery (seasonal percentages by weight) for the eight outfalls that were spiked at the beginning of the 2001-2002 storm season. The figure shows that approximately 45 percent of the total spike mass was recovered by the third event (Event 2001-03) and that 59 percent of the spikes were recovered over the 2001-2002 storm season. The figure shows that with low storm intensities and low litter collection, low spike recovery percentages are also recorded. Conversely, results from Event 2001-14 show that a higher percentage of spike recovery appears related to maximum rainfall intensity and litter collection.

Overall, it appears that a large percentage of spikes were recovered during the first three sample collections (Events 2001-02, 2001-03, and 2001-04). This trend may represent a litter first flush occurring in the first portion of the rain season. It should be noted that under half of the spikes (45%) placed were recovered during this first flush period and that substantial spikes were recovered later in the season (14%) or have not yet been recovered (the remaining 41%). It would be expected that other loose material present in the inlets before the storm season could experience similar transport during early season storms or during higher intensity storms in February and March 2002.

Figure 3-7
2001-2002 SEASON SPIKE RECOVERY/FIRST FLUSH ASSESSMENT



Notes:

- 1) Rainfall intensities computed from rainfall recorded at site SR 180-PE2 gauging station, except for event 2001-14, which was computed from rainfall data recorded at site SR 41-PE6.
- 2) Rainfall intensities computed as the maximum event rainfall depth over the sampling interval divided by the interval time.
- 3) Percent total litter collected by event is computed as the sum of air-dried litter weight collected at the eight spiked outfalls divided by the seasonal total of air-dried litter weight collected at these outfalls.
- 4) Percent spikes recovered per event is computed as the sum of spike weight collected at the eight spiked outfalls divided by the total weight of spikes placed at these eight outfalls.

SECTION FOUR

- Caltrans (California Department of Transportation), 2001a. *Caltrans Public Education Litter Monitoring Study Sampling and Analysis Plan, Addendum No. 1*, October 2001, supplement to Caltrans Doc. No. CTSW-RT-00-038.
- 2000a. *Caltrans Public Education Litter Monitoring Study Sampling and Analysis Plan*, December 2000, Caltrans Doc. No. CTSW-RT-00-038.
- 2000b. *Guidance Manual: Stormwater Monitoring Protocols*, July 2000, Caltrans Doc. No. CT-SW-RT-00-005.
- 2000c. *Guidance for Monitoring Storm Water Litter*, October 2000 Caltrans Doc. No. CTSW-RT-00-025.
- 2000d. *Caltrans Storm Water Management Plan*, May 2001 (SWRCB Resolution No. 2001-070).

APPENDIX A

APPENDIX A

Site Photographs

Monitoring Site R180-PE1 Surface Conditions**Monitoring Site R180-PE2 Surface Conditions**

Monitoring Site R180-PE3 Surface Conditions**Monitoring Site R180-PE4 Surface Conditions**

Monitoring Site R41-PE6 Surface Conditions**Monitoring Site R41-PE7 Surface Conditions**

Monitoring Site R41-PE8 Surface Conditions**Monitoring Site R41-PE16 Surface Conditions**

Monitoring Site 6-06 Surface Conditions**Monitoring Site R99-PE-11 Surface Conditions**

Monitoring Site R99-PE-12 Surface Conditions**Monitoring Site R99-PE-13 Surface Conditions**

Monitoring Site S180-PE14 Surface Conditions



Monitoring Site S180-PE15 Surface Conditions



Monitoring Site I5-PE9 Surface Conditions**Monitoring Site I5-PE10 Surface Conditions**

APPENDIXB

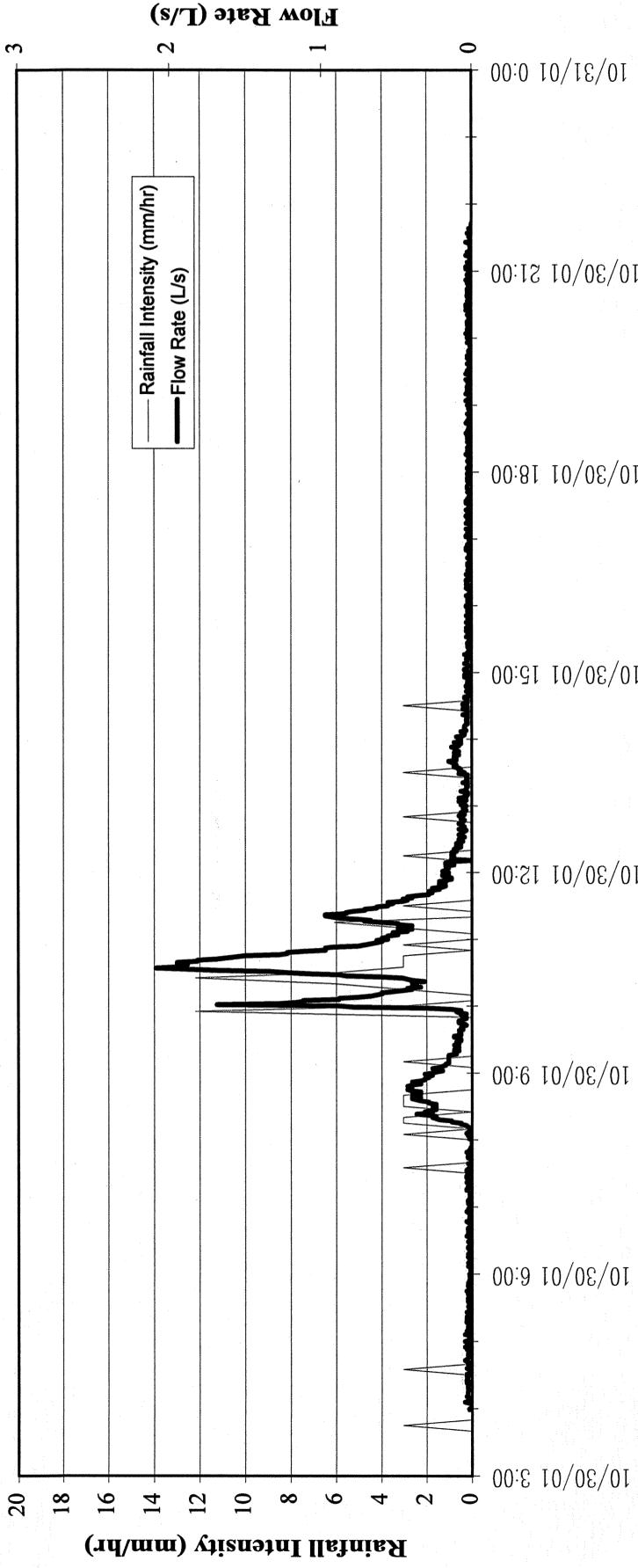
APPENDIX B

Event Hydrographs

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-02

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Date/Time

Runoff Data

Rain Data

| | | | |
|------------------------------|----------------|------------------------|----------------|
| Start Date/Time: | 10/30/01 04:35 | Start Date/Time: | 10/30/01 03:59 |
| Stop Date/Time: | 10/30/01 14:30 | Stop Date/Time: | 10/30/01 21:44 |
| Event Rain (mm): | 8.64 | Total Flow Volume (L): | 8127 |
| Max Intensity (mm/hr): | 12.19 | Peak Flow (L/s): | 2.09 |
| Observed Runoff Coefficient: | 0.125 | | |

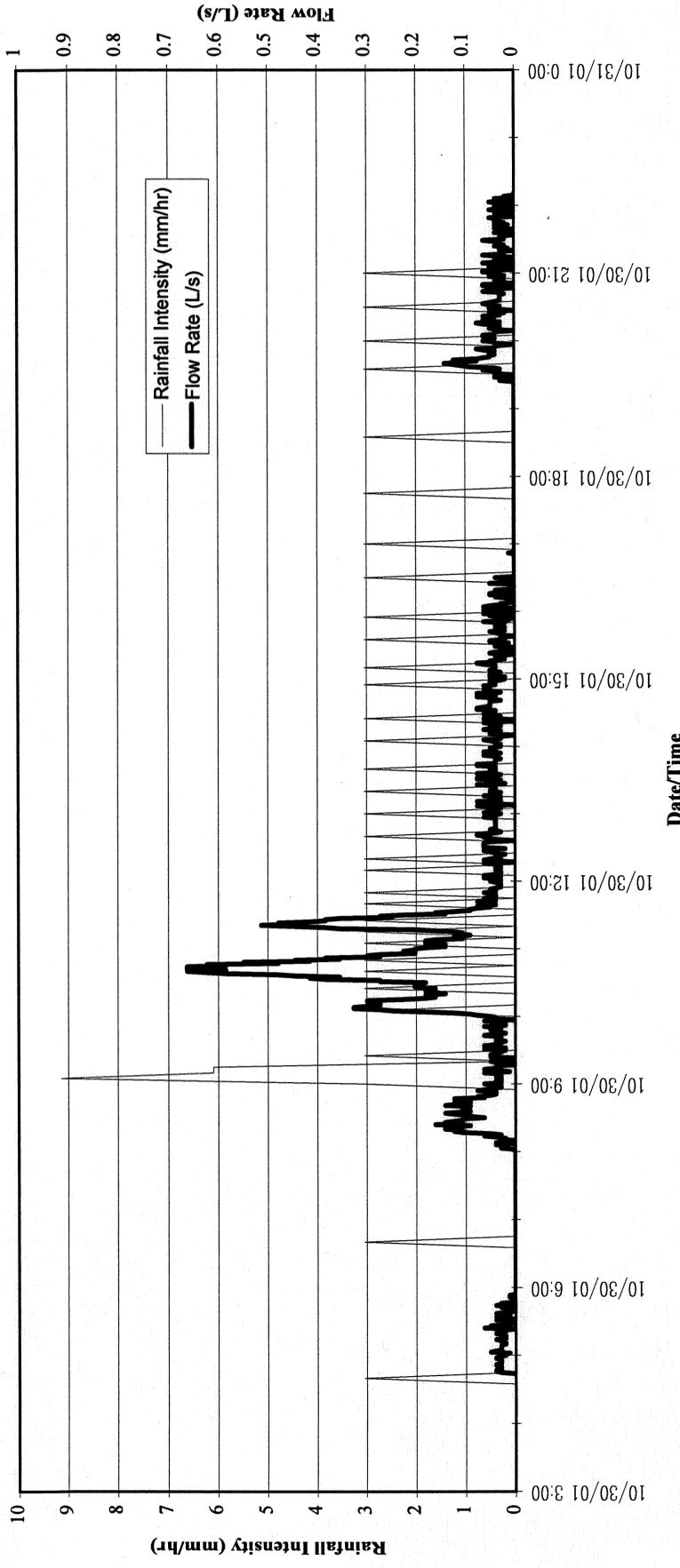
Notes:

Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Event Summary

Site: R41-PE6 (6-209)
Event: 2001-02

Catchment Area (ha): 0.13
Assumed Runoff Coefficient: 0.72



Rain Data

| | |
|------------------------|----------------|
| Start Date/Time: | 10/30/01 04:40 |
| Stop Date/Time: | 10/30/01 21:00 |
| Event Rain (mm): | 9.91 |
| Max Intensity (mm/hr): | 9.14 |

Runoff Data

| | |
|------------------------------|----------------|
| Start Date/Time: | 10/30/01 04:45 |
| Stop Date/Time: | 10/30/01 22:12 |
| Total Flow Volume (L): | 3177 |
| Peak Flow (L/s): | 0.66 |
| Observed Runoff Coefficient: | 0.247 |

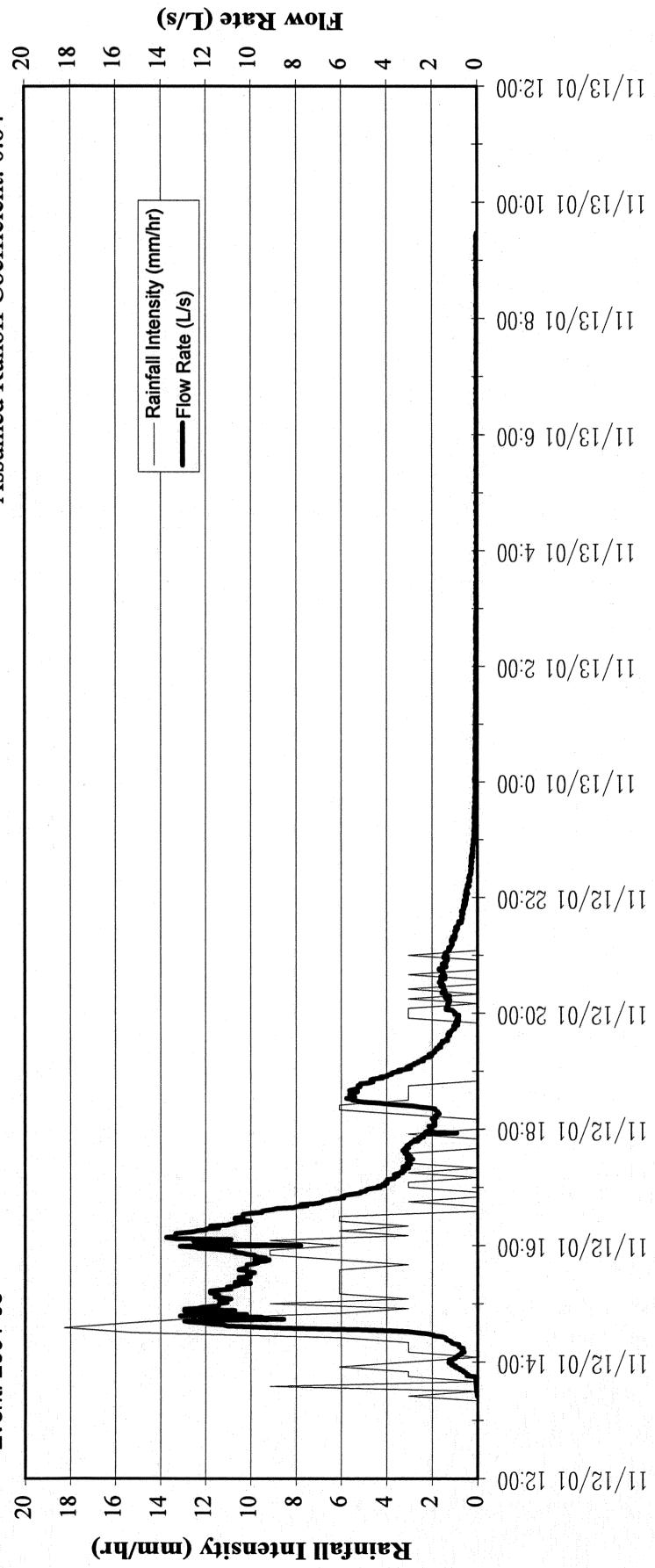
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

Notes:

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-03

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Rain Data

Start Date/Time: 11/12/01 13:25
Stop Date/Time: 11/12/01 21:00
Event Rain (mm): 24.89
Max Intensity (mm/hr):
Observed Runoff Coefficient:

Runoff Data

Start Date/Time: 11/12/01 13:25
Stop Date/Time: 11/13/01 09:29
Total Flow Volume (L): 135746
Peak Flow (L/s): 13.74
Observed Runoff Coefficient: 0.727

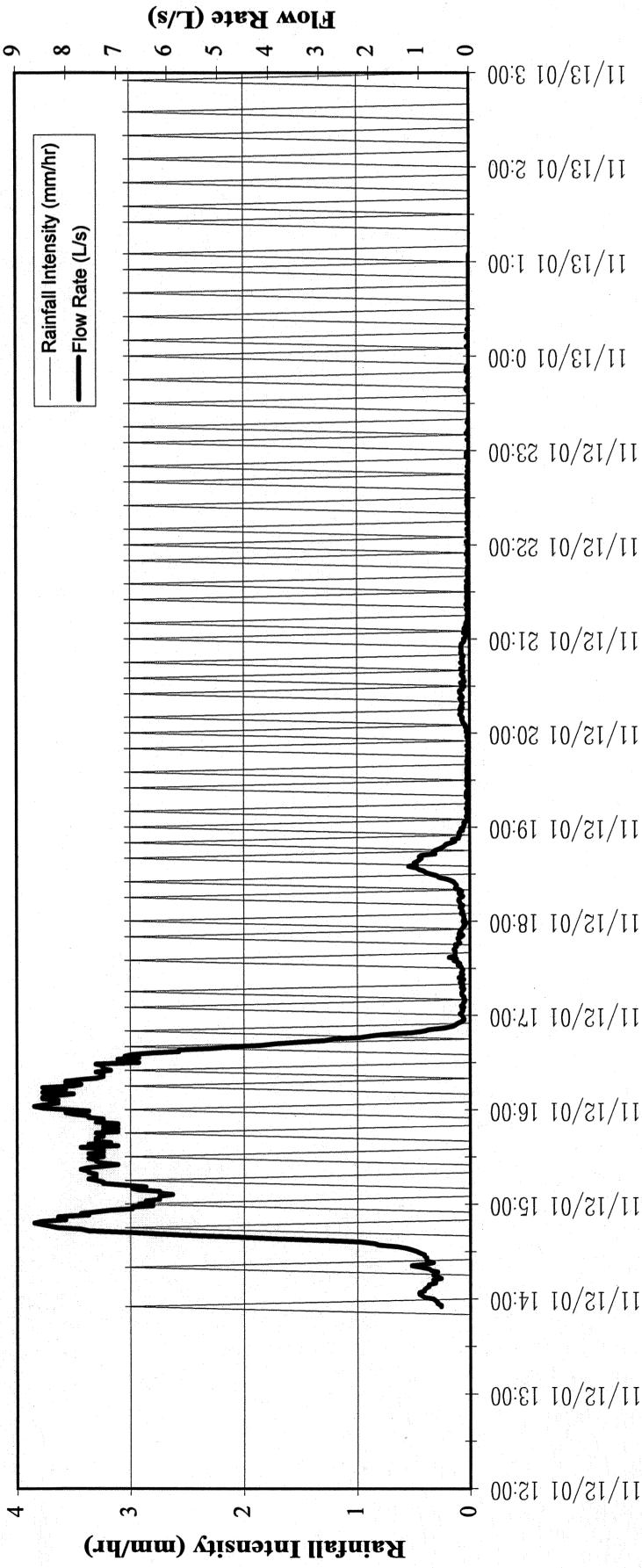
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

Notes:

Event Summary

Site: R41-PE6 (6-209)
Event: 2001-03

Catchment Area (ha): 0.13
Assumed Runoff Coefficient: 0.72



Rain Data

| | Rain Date | Runoff Data |
|------------------------------|----------------|------------------------------------|
| Start Date/Time: | 11/12/01 13:55 | Start Date/Time: 11/12/01 13:55 |
| Stop Date/Time: | 11/13/01 16:00 | Stop Date/Time: 11/13/01 01:06 |
| Event Rain (mm): | 24.13 | Total Flow Volume (L): 61104 |
| Max Intensity (mm/hr): | 3.05 | Peak Flow (L/s): 8.65 |
| Observed Runoff Coefficient: | | Observed Runoff Coefficient: 1.948 |

Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

Notes: Due to a clogged rain gage at this station site R180-PE2 (6-205) rain data should be used for this event (24.89 mm). Due to observed flooding at the site the total flow volume and observed runoff coefficient is not reliable and is estimated to be 22,400 liters for the above period.

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-04

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Runoff Data

Rain Data

| | | | |
|------------------------------|----------------|------------------------|----------------|
| Start Date/Time: | 11/22/01 08:00 | Start Date/Time: | 11/22/01 08:02 |
| Stop Date/Time: | 11/22/01 09:05 | Stop Date/Time: | 11/22/01 23:59 |
| Event Rain (mm): | 3.05 | Total Flow Volume (L): | 5775 |
| Max Intensity (mm/hr): | 6.10 | Peak Flow (L/s): | 0.97 |
| Observed Runoff Coefficient: | 0.253 | | |

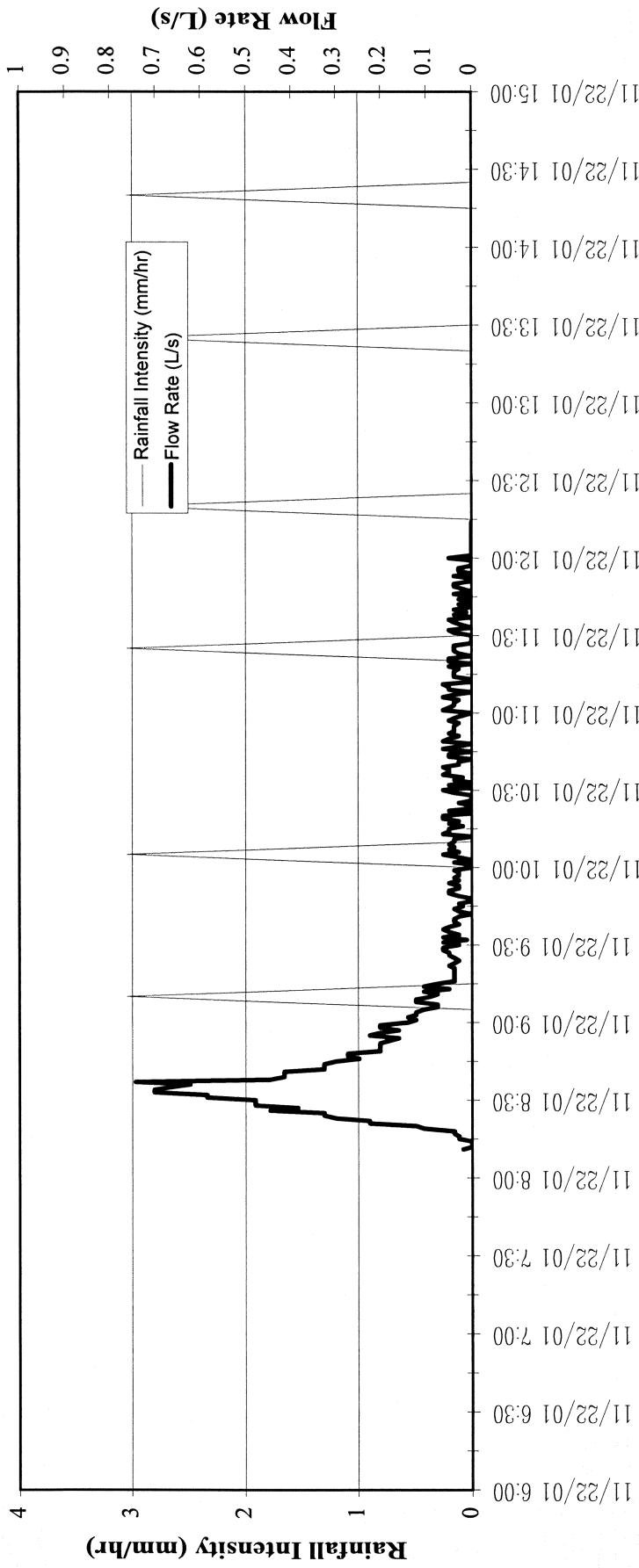
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Notes:

Event Summary

Site: R41-PE6 (6-209)
Event: 2001-04

Catchment Area (ha): 0.13
Assumed Runoff Coefficient: 0.72



| <u>Rain Data</u> | <u>Runoff Data</u> |
|------------------------------|--------------------|
| Start Date/Time: | 11/22/01 08:00 |
| Stop Date/Time: | 11/23/01 07:35 |
| Event Rain (mm): | 2.29 |
| Max Intensity (mm/hr): | 3.05 |
| Observed Runoff Coefficient: | 0.432 |
| Start Date/Time: | 11/22/01 08:11 |
| Stop Date/Time: | 11/22/01 12:15 |
| Total Flow Volume (L): | 1284 |
| Peak Flow (L/s): | 0.74 |

Notes:

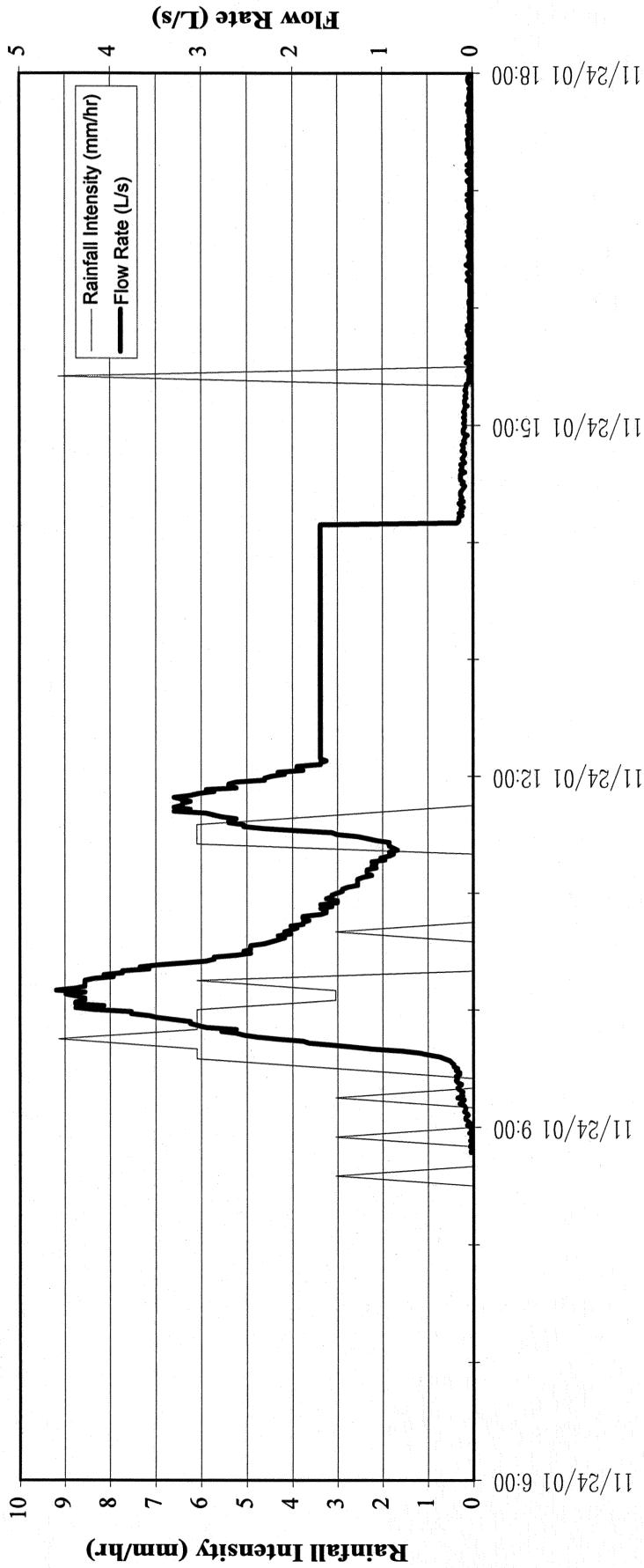
Due to a clogged rain gage at this station site R180-PE2 (6-205) rain data should be used for this event (3.05 mm).

Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (Version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-05

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Date/Time

Rain Data

Start Date/Time: 11/24/01 08:35
Stop Date/Time: 11/24/01 15:25
Event Rain (mm): 7.37
Max Intensity (mm/hr): 9.14

Runoff Data

Start Date/Time: 11/24/01 08:47
Stop Date/Time: 11/25/01 11:07
Total Flow Volume (L): 38061
Peak Flow (L/s): 4.60
Observed Runoff Coefficient: 0.689

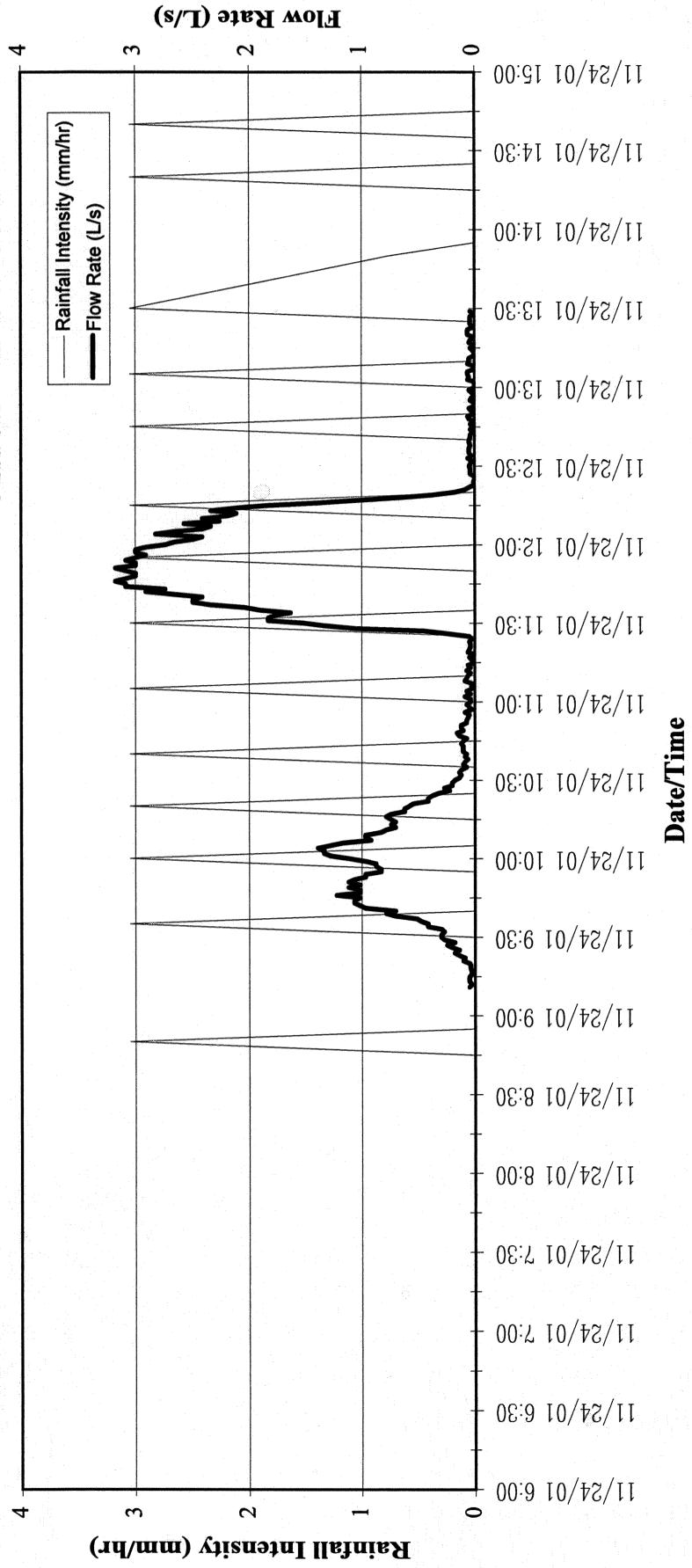
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Notes: The level measurement (bubbler) malfunctioned during the storm. Total flow volume and observed runoff coefficient data above are not reliable. Total Flow volume is estimated to be 16,900 Liters for the above period.

Event Summary

Site: R41-PE6 (6-209)
Event: 2001-05

Catchment Area (ha): 0.13
Assumed Runoff Coefficient: 0.72



Rain Data

| | Rain Date | Runoff Data |
|------------------------------|----------------|------------------------------------|
| Start Date/Time: | 11/24/01 08:50 | Start Date/Time: 11/24/01 09:11 |
| Stop Date/Time: | 11/25/01 05:25 | Stop Date/Time: 11/24/01 13:30 |
| Event Rain (mm): | 8.64 | Total Flow Volume (L): 10768 |
| Max Intensity (mm/hr): | 3.05 | Peak Flow (L/s): 3.18 |
| Observed Runoff Coefficient: | | Observed Runoff Coefficient: 0.959 |

Notes:

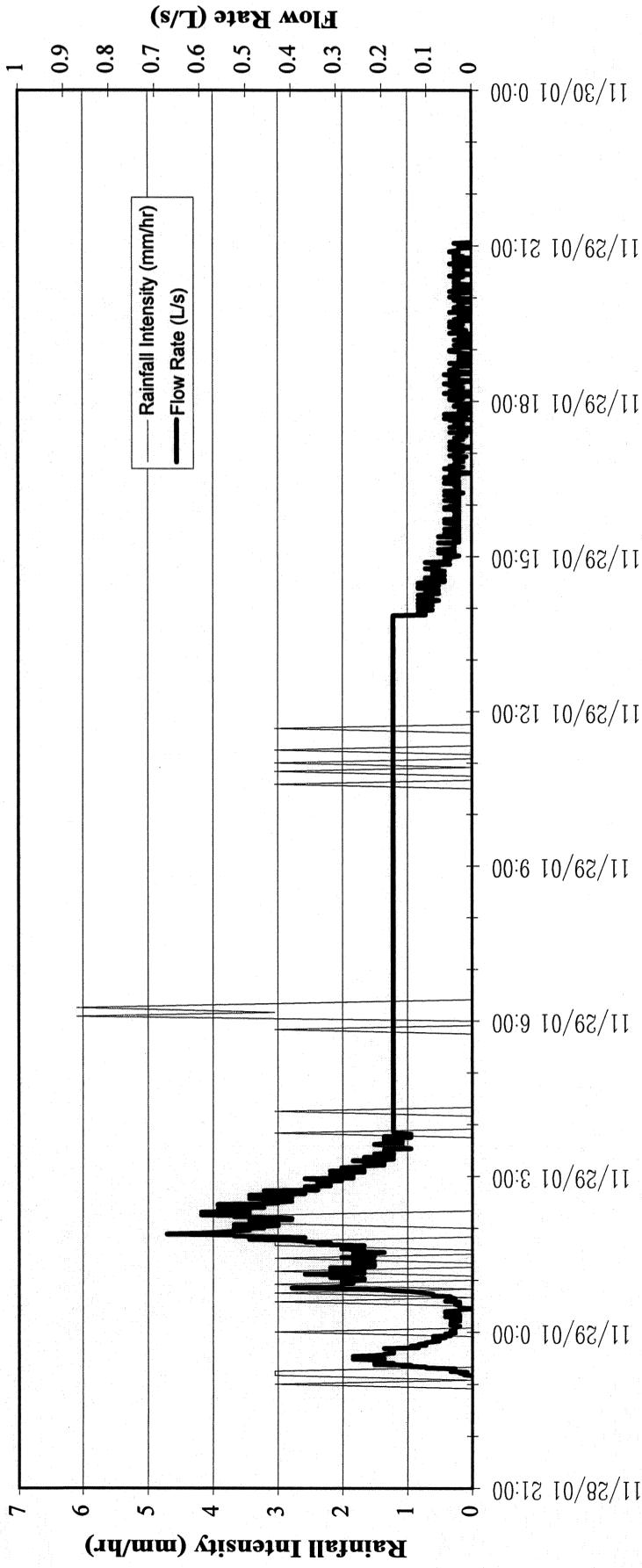
Due to a clogged rain gage at this station site R180-PE2 (6-205) rain data should be used for this event (7.37 mm). Due to observed flooding at the site the total flow volume and observed runoff coefficient are not reliable. Total flow is estimated to be 2750 Liters for the above period.

Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-06

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Rain Data

| | | | |
|------------------------|----------------|------------------------|----------------|
| Start Date/Time: | 11/28/01 23:00 | Start Date/Time: | 11/28/01 23:10 |
| Stop Date/Time: | 11/29/01 11:40 | Stop Date/Time: | 11/29/01 21:05 |
| Event Rain (mm): | 6.86 | Total Flow Volume (L): | 11327 |
| Max Intensity (mm/hr): | 6.10 | Peak Flow (L/s): | 0.67 |

Observed Runoff Coefficient: 0.220

Runoff Data

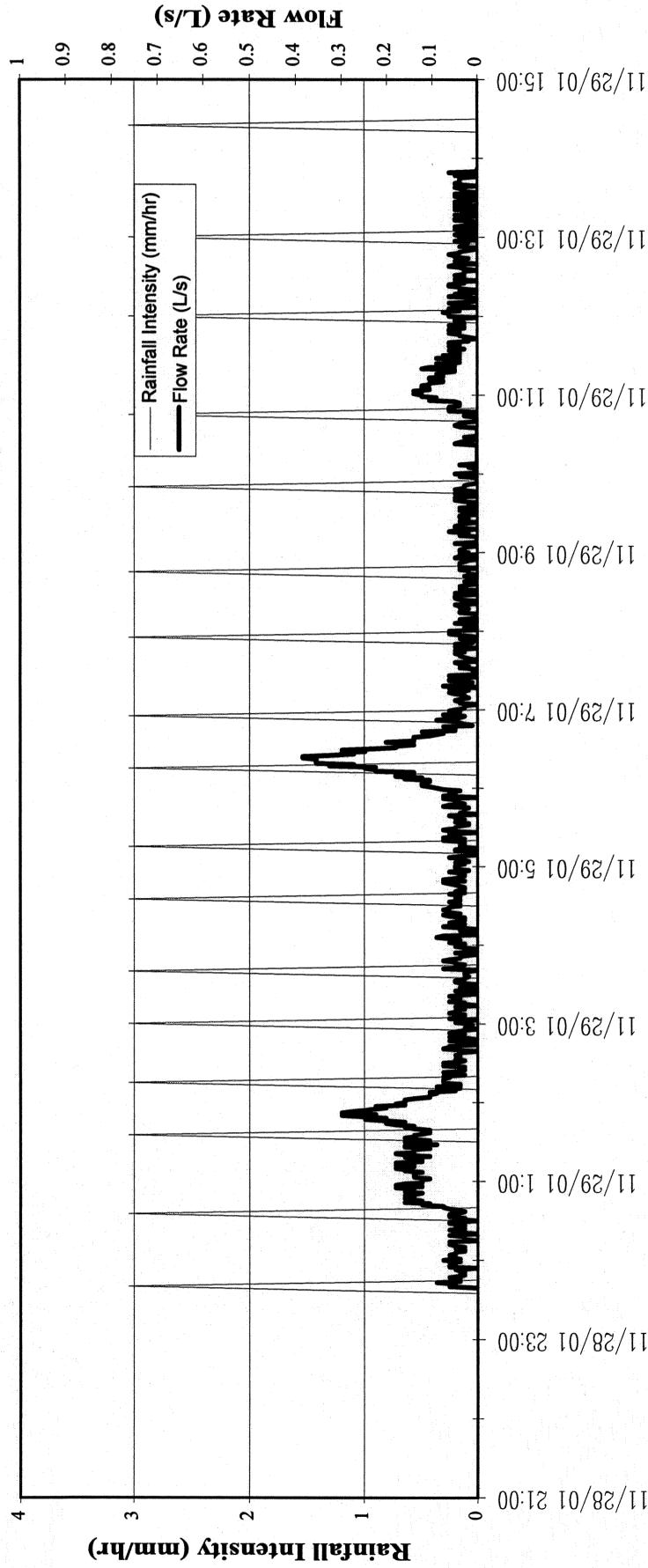
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Notes: The level measurement (bubbler) malfunctioned during the storm. Total flow volume and observed runoff coefficient data are not reliable.
Total Flow is estimated to be 13,660 Liters for the above period.

Event Summary

Site: R41-PE6 (6-209)
Event: 2001-06

Catchment Area (ha): 0.13
Assumed Runoff Coefficient: 0.72



Runoff Data

Rain Data

Start Date/Time: 11/28/01 23:00
Stop Date/Time: 11/30/01 11:55
Event Rain (mm): 6.35
Max Intensity (mm/hr): 3.05

Start Date/Time: 11/28/01 23:40

Stop Date/Time: 11/29/01 13:53

Total Flow Volume (L): 2930

Peak Flow (L/s): 0.38

Observed Runoff Coefficient: 0.355

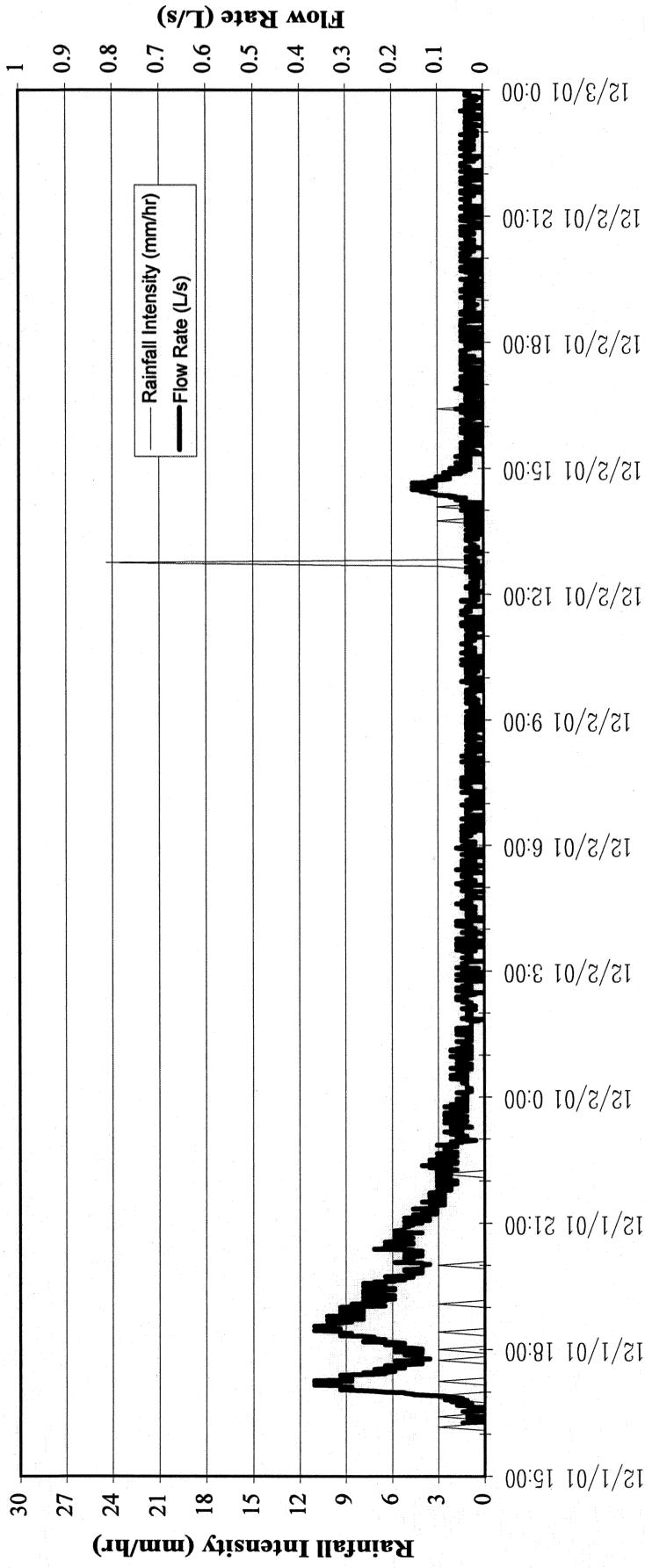
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Notes: Due to a clogged rain gage at this station site R180-PE2 (6-205) rain data should be used for this event (6.86 mm).

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-07

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Rain Data

| | Rain Date | Runoff Data |
|------------------------------|----------------|------------------------------------------------------------------|
| Start Date/Time: | 12/01/01 16:10 | Start Date/Time: 12/01/01 16:16 |
| Stop Date/Time: | 12/02/01 16:25 | Stop Date/Time: 12/02/01 23:59 |
| Event Rain (mm): | 5.59 | Total Flow Volume (L): 6875 |
| Max Intensity (mm/hr): | 24.38 | Peak Flow (L/s): 0.37 |
| Observed Runoff Coefficient: | 0.164 | Associated with the latter collection event, refer to Section 2. |

Notes:

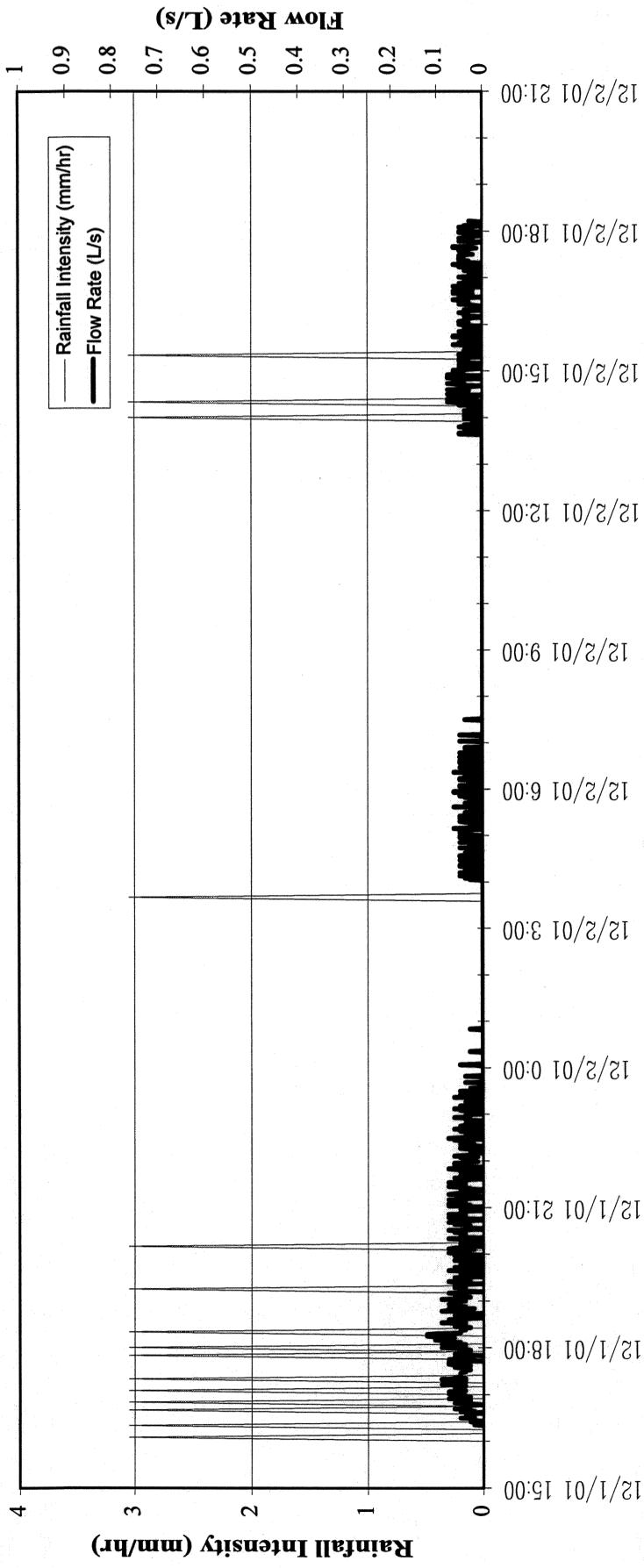
A rain value of 2.03 mm at 12/2/2002 12:45 PM appears to be anomalous per R41-PE2 and FAT rain records. Estimated Max Intensity and Event Rain is 3.05 mm/hr and 3.81 mm, respectively. Adjusted runoff coefficient is 0.241.

Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

Event Summary

Site: R41-PE6 (6-209)
Event: 2001-07

Catchment Area (ha): 0.13
Assumed Runoff Coefficient: 0.72



Rain Data

| | | | |
|------------------------|----------------|------------------------|----------------|
| Start Date/Time: | 12/01/01 16:05 | Start Date/Time: | 12/01/01 16:20 |
| Stop Date/Time: | 12/01/01 20:10 | Stop Date/Time: | 12/02/01 18:14 |
| Event Rain (mm): | 2.54 | Total Flow Volume (L): | 1790 |
| Max Intensity (mm/hr): | 3.05 | Peak Flow (L/s): | 0.12 |

Runoff Data

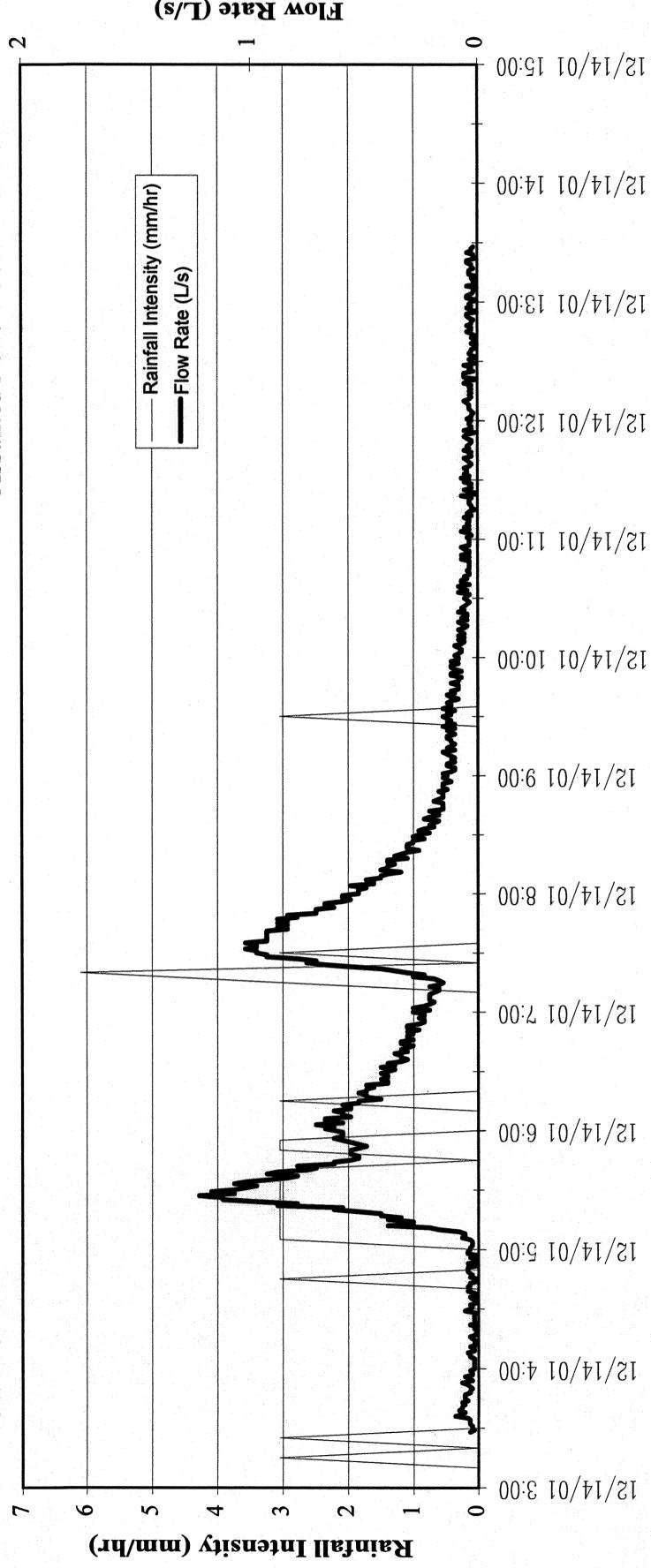
| |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2. |
| Observed Runoff Coefficient: 0.542 |

Notes:

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-08

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Rain Data

| | |
|------------------------|----------------|
| Start Date/Time: | 12/14/01 03:15 |
| Stop Date/Time: | 12/14/01 09:30 |
| Event Rain (mm): | 4.57 |
| Max Intensity (mm/hr): | 6.10 |

Runoff Data

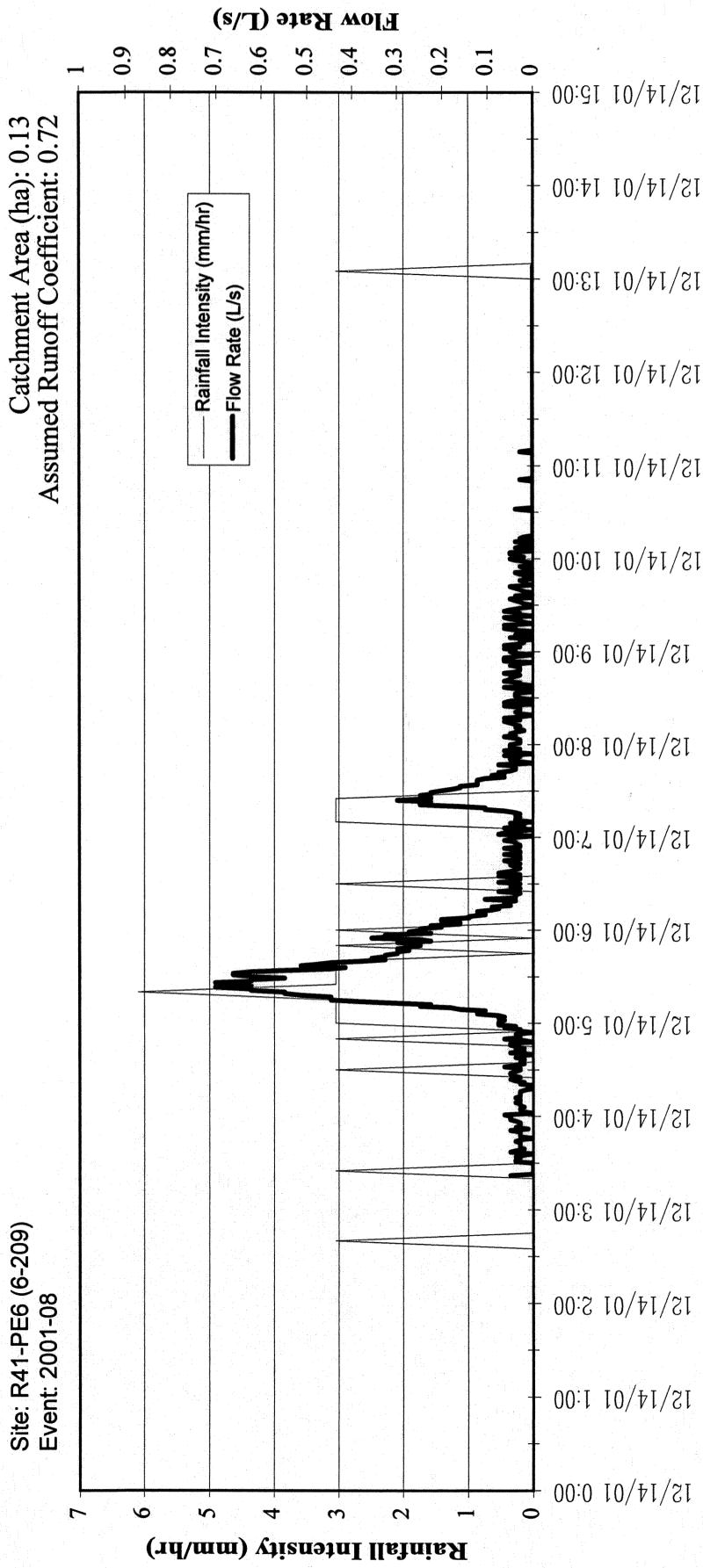
| | |
|------------------------------|----------------|
| Start Date/Time: | 12/14/01 03:28 |
| Stop Date/Time: | 12/14/01 13:29 |
| Total Flow Volume (L): | 7924 |
| Peak Flow (L/s): | 1.22 |
| Observed Runoff Coefficient: | 0.231 |

Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

Notes:

Event Summary

Site: R41-PE6 (6-209)
Event: 2001-08



Rain Data

Start Date/Time:

12/14/01 02:40

Stop Date/Time:

12/14/01 13:05

Total Flow Volume (L):

2356

Peak Flow (L/s):

0.70

Observed Runoff Coefficient:

0.340

Runoff Data

Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

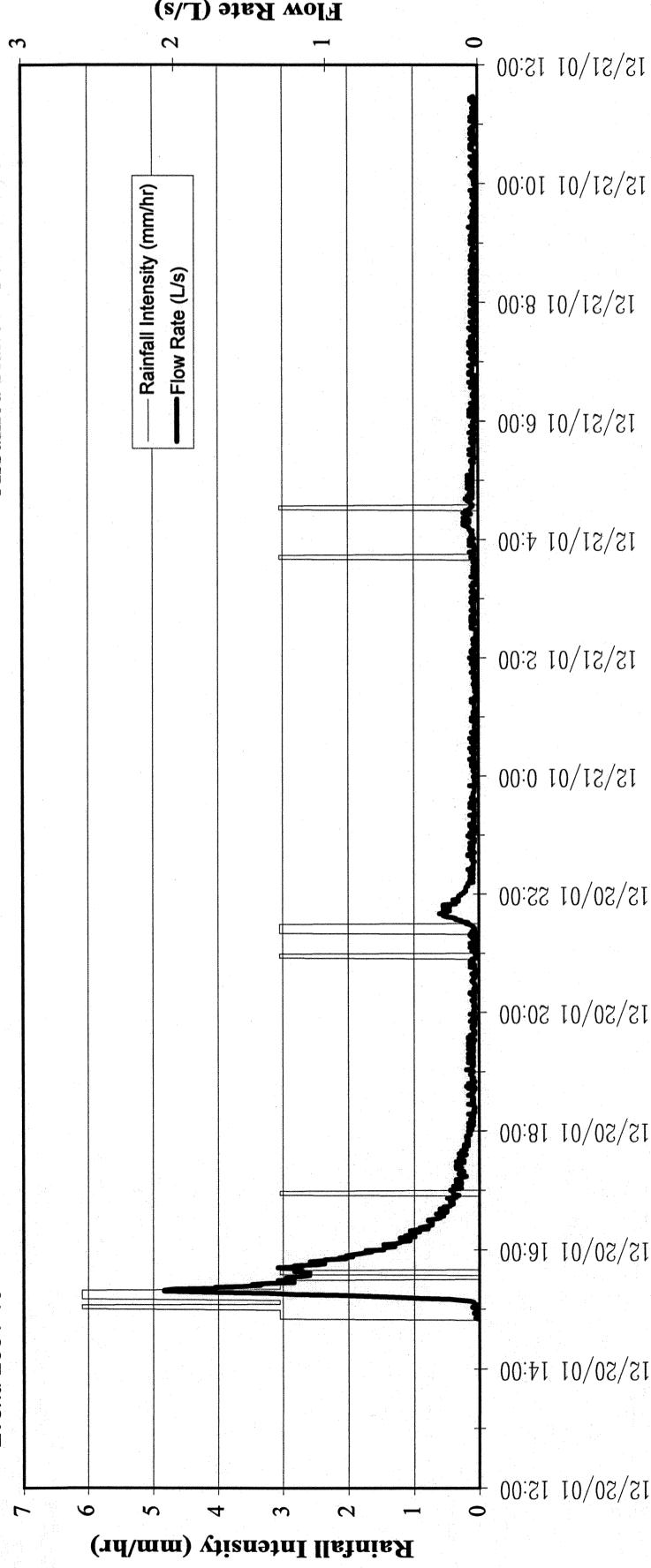
| | Start Date/Time: | Stop Date/Time: | Total Flow Volume (L): | Peak Flow (L/s): | Observed Runoff Coefficient: |
|-------------|------------------|-----------------|------------------------|------------------|------------------------------|
| Rain Data | 12/14/01 02:40 | 12/14/01 03:22 | 2356 | 0.70 | 0.340 |
| Runoff Data | 12/14/01 13:10 | | | | |

Notes:

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-10

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Rain Data

Start Date/Time: 12/20/01 14:50
Stop Date/Time: 12/20/01 21:25
Event Rain (mm): 3.81
Max Intensity (mm/hr): 6.10

Runoff Data

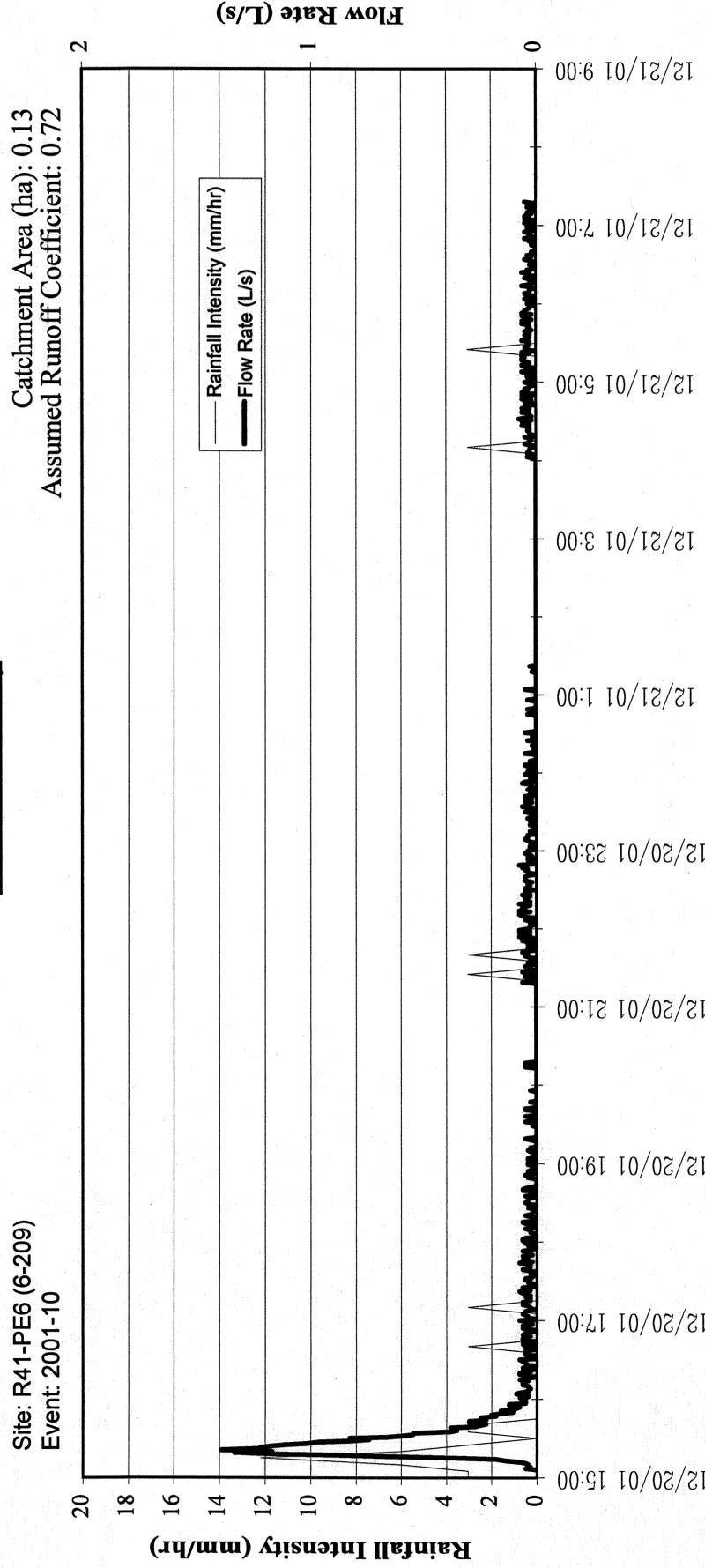
Start Date/Time: 12/20/01 14:50
Stop Date/Time: 12/21/01 11:29
Total Flow Volume (L): 7570
Peak Flow (L/s): 2.07
Observed Runoff Coefficient: 0.265

Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

Notes:

Event Summary

Site: R41-PE6 (6-209)
Event: 2001-10



Rain Data

| | | | |
|------------------------|----------------|------------------------|----------------|
| Start Date/Time: | 12/20/01 15:00 | Start Date/Time: | 12/20/01 15:06 |
| Stop Date/Time: | 12/20/01 21:40 | Stop Date/Time: | 12/21/01 07:19 |
| Event Rain (mm): | 4.06 | Total Flow Volume (L): | 2561 |
| Max Intensity (mm/hr): | 12.19 | Peak Flow (L/s): | 1.39 |

Runoff Data

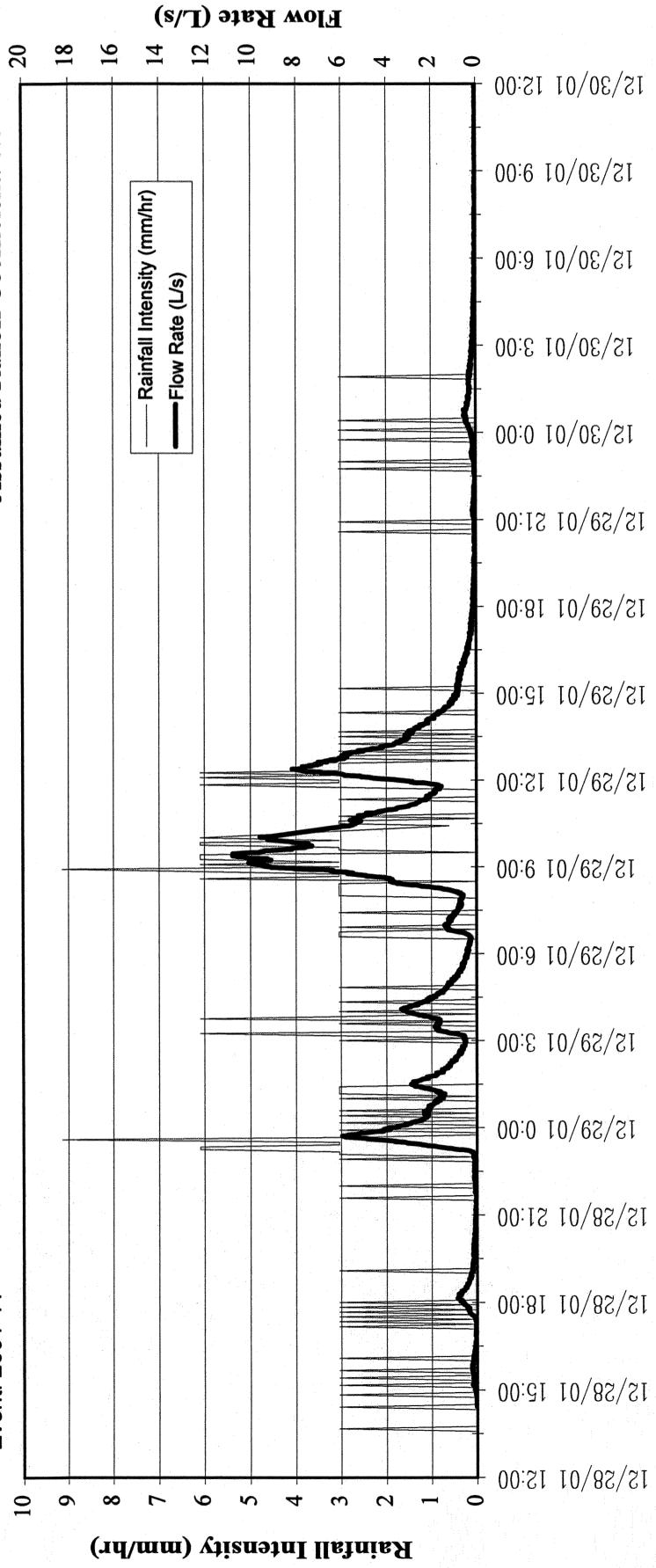
| | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Observed Runoff Coefficient: | 0.485 |
| Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2. | |

Notes:

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-11

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Rain Data

| | Rain Date | Runoff Data |
|------------------------|----------------|------------------------------------|
| Start Date/Time: | 12/28/01 13:40 | Start Date/Time: 12/28/01 14:26 |
| Stop Date/Time: | 12/30/01 01:55 | Stop Date/Time: 12/30/01 11:59 |
| Event Rain (mm): | 30.99 | Total Flow Volume (L): 183947 |
| Max Intensity (mm/hr): | 9.14 | Peak Flow (L/s): 10.78 |
| | | Observed Runoff Coefficient: 0.791 |

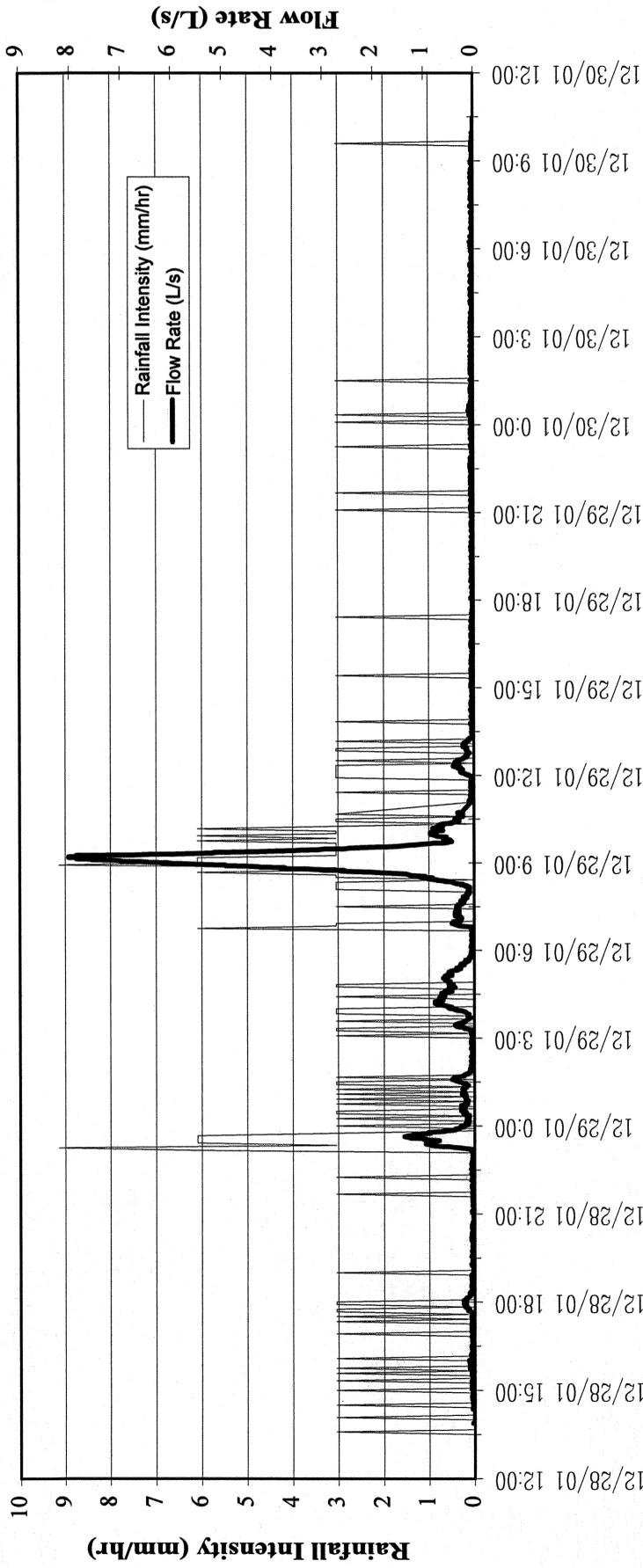
Notes:

Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Event Summary

Site: R41-PE6 (6-209)
Event 2001-11

Catchment Area (ha): 0.13
Assumed Runoff Coefficient: 0.72



Rain Data

| | | | |
|------------------------|----------------|------------------------------|----------------|
| Start Date/Time: | 12/28/01 13:35 | Start Date/Time: | 12/28/01 13:53 |
| Stop Date/Time: | 12/30/01 01:30 | Stop Date/Time: | 12/30/01 10:29 |
| Event Rain (mm): | 29.46 | Total Flow Volume (L): | 33845 |
| Max Intensity (mm/hr): | 9.14 | Peak Flow (L/s): | 8.03 |
| | | Observed Runoff Coefficient: | 0.884 |

Runoff Data

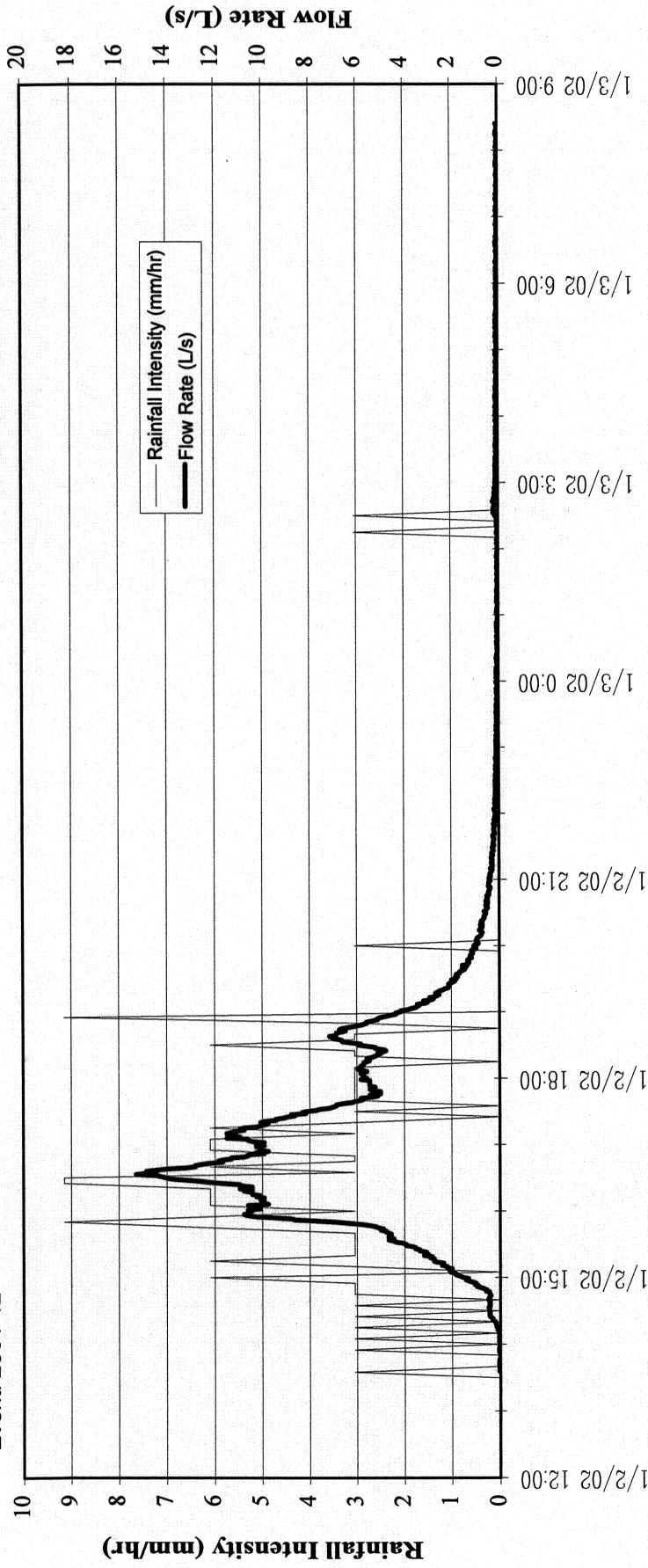
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Notes:

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-12

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Rain Data

Start Date/Time:

01/02/02 13:35

Stop Date/Time:

01/02/02 20:00

Event Rain (mm):

18.80

Max Intensity (mm/hr):

9.14

Observed Runoff Coefficient:

0.867

Runoff Data

Start Date/Time:

01/02/02 13:35

Stop Date/Time:

01/03/02 08:25

Total Flow Volume (L):

122263

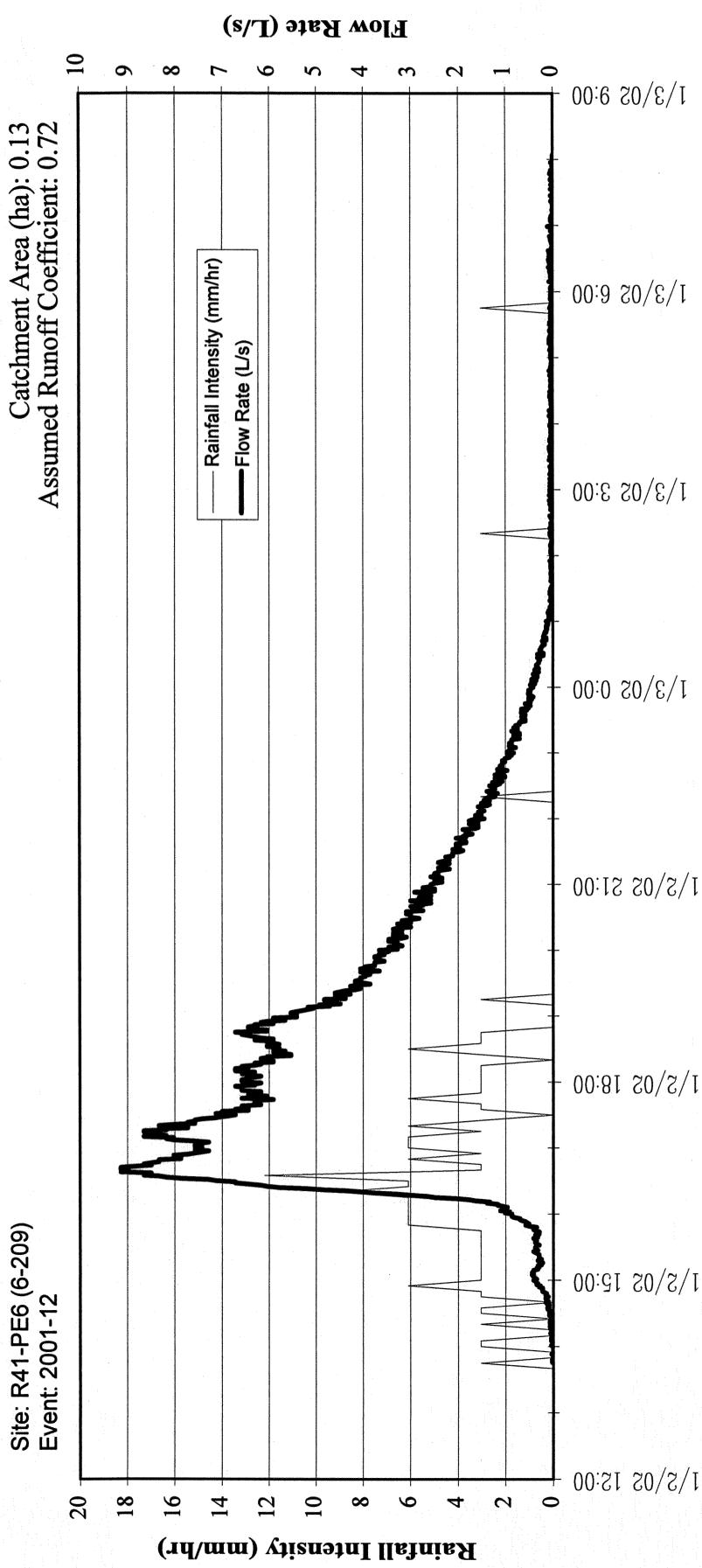
Peak Flow (L/s):

15.29

Notes:

Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

Event Summary



Rain Data

Start Date/Time: 01/02/02 13:45
Stop Date/Time: 01/03/02 05:45
Event Rain (mm): 19.56
Max Intensity (mm/hr): 12.19

Runoff Data

Start Date/Time: 01/02/02 13:45
Stop Date/Time: 01/03/02 08:05
Total Flow Volume (L): 112354
Peak Flow (L/s): 9.14
Observed Runoff Coefficient: 4.419

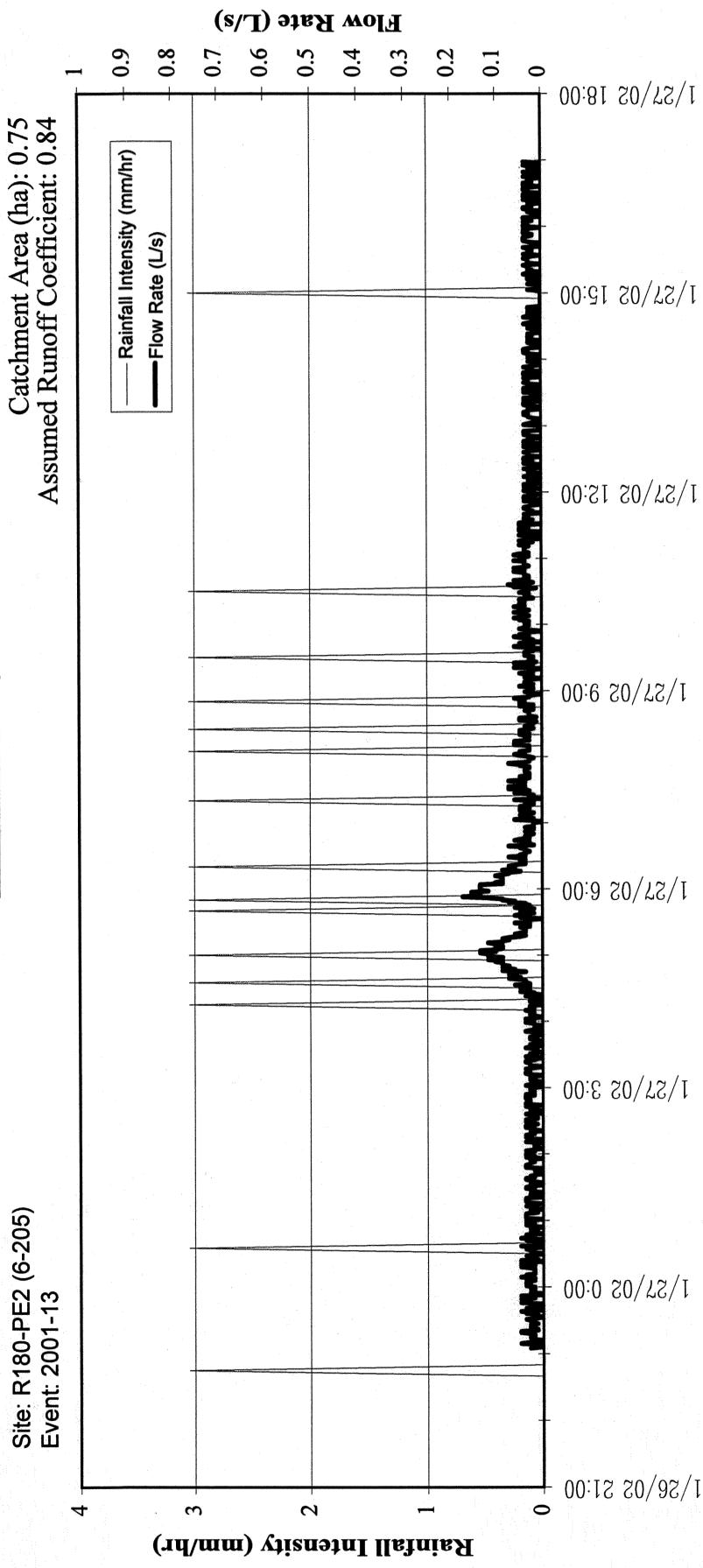
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Notes:

Due to observed flooding at the site the total flow volume and observed runoff coefficient are not reliable. Total Flow is estimated to be 18,300 Liters for the above period.

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-13



Date/Time

Rain Data

Start Date/Time: 01/27/02 04:15
Stop Date/Time: 01/27/02 15:00
Event Rain (mm): 2.54
Max Intensity (mm/hr):

Runoff Data

Start Date/Time: 01/26/02 23:05
Stop Date/Time: 01/27/02 16:59
Total Flow Volume (L): 1968
Peak Flow (L/s): 0.17
Observed Runoff Coefficient: 0.086

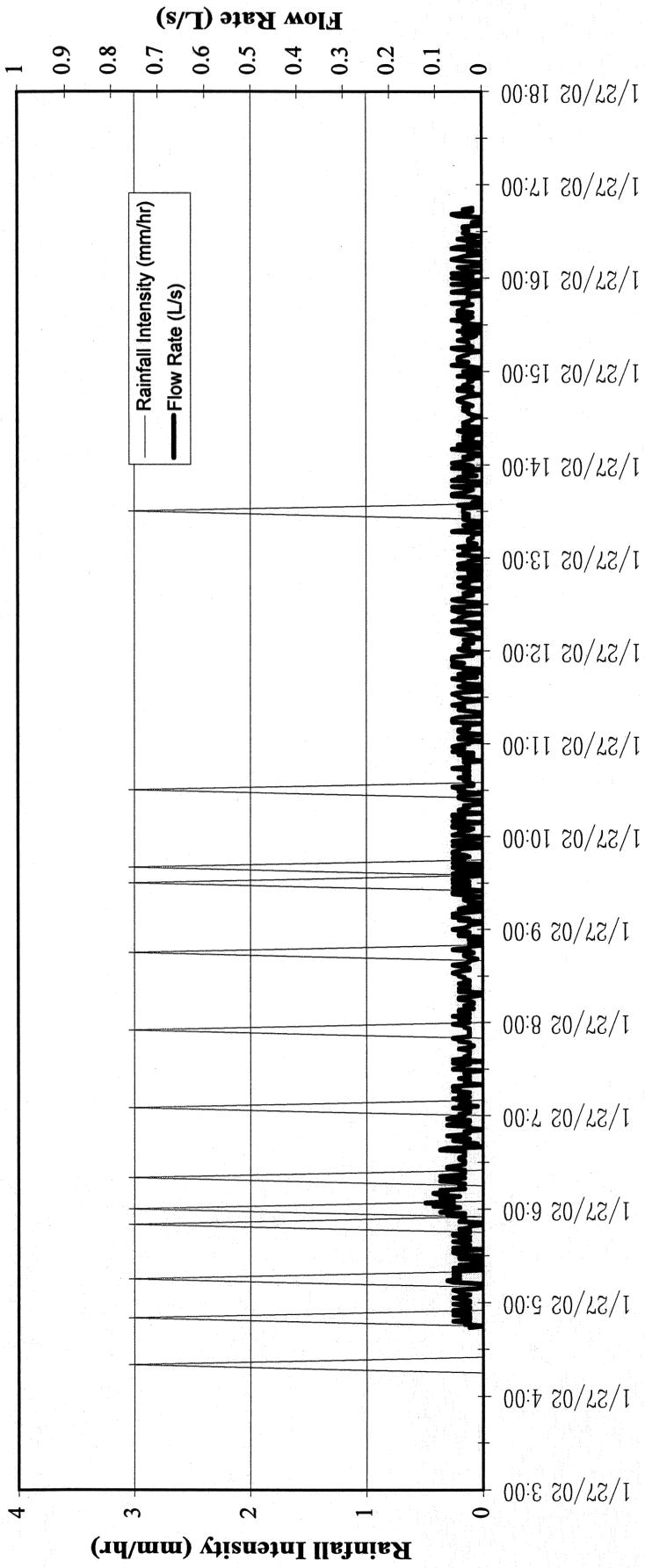
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

Notes:

Event Summary

Site: R41-PE6 (6-209)
Event: 2001-13

Catchment Area (ha): 0.13
Assumed Runoff Coefficient: 0.72



Runoff Data

| <u>Rain Data</u> | <u>Runoff Data</u> |
|------------------------------|--------------------|
| Start Date/Time: | 01/27/02 04:20 |
| Stop Date/Time: | 01/27/02 13:30 |
| Event Rain (mm): | 2.54 |
| Max Intensity (mm/hr): | 3.05 |
| | |
| Observed Runoff Coefficient: | 0.383 |

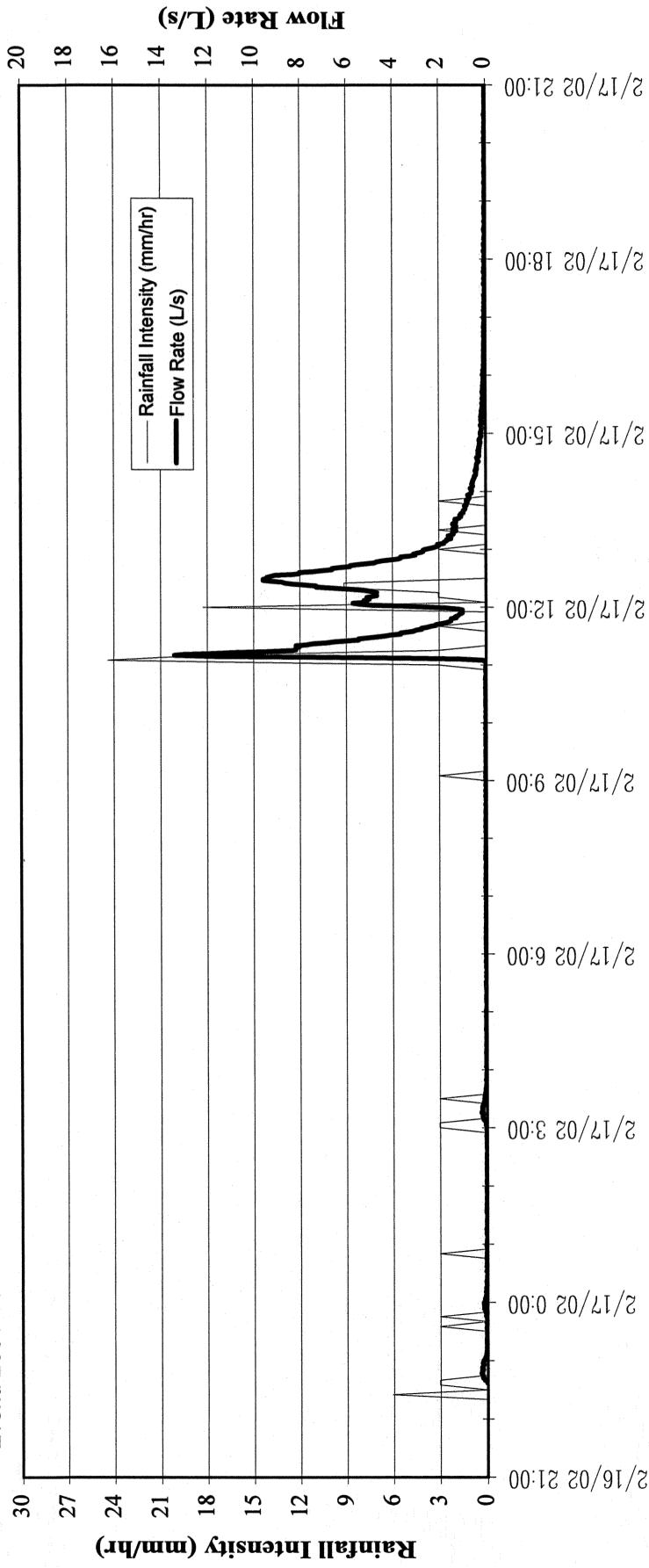
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Notes:

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-14

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Date/Time

Rain Data

Start Date/Time: 02/17/02 09:05
Stop Date/Time: 02/17/02 13:50
Event Rain (mm): 8.64
Max Intensity (mm/hr):

Start Date/Time: 02/16/02 22:37
Stop Date/Time: 02/18/02 09:50
Total Flow Volume (L): 45934
Peak Flow (L/s): 13.42
Observed Runoff Coefficient: 0.709

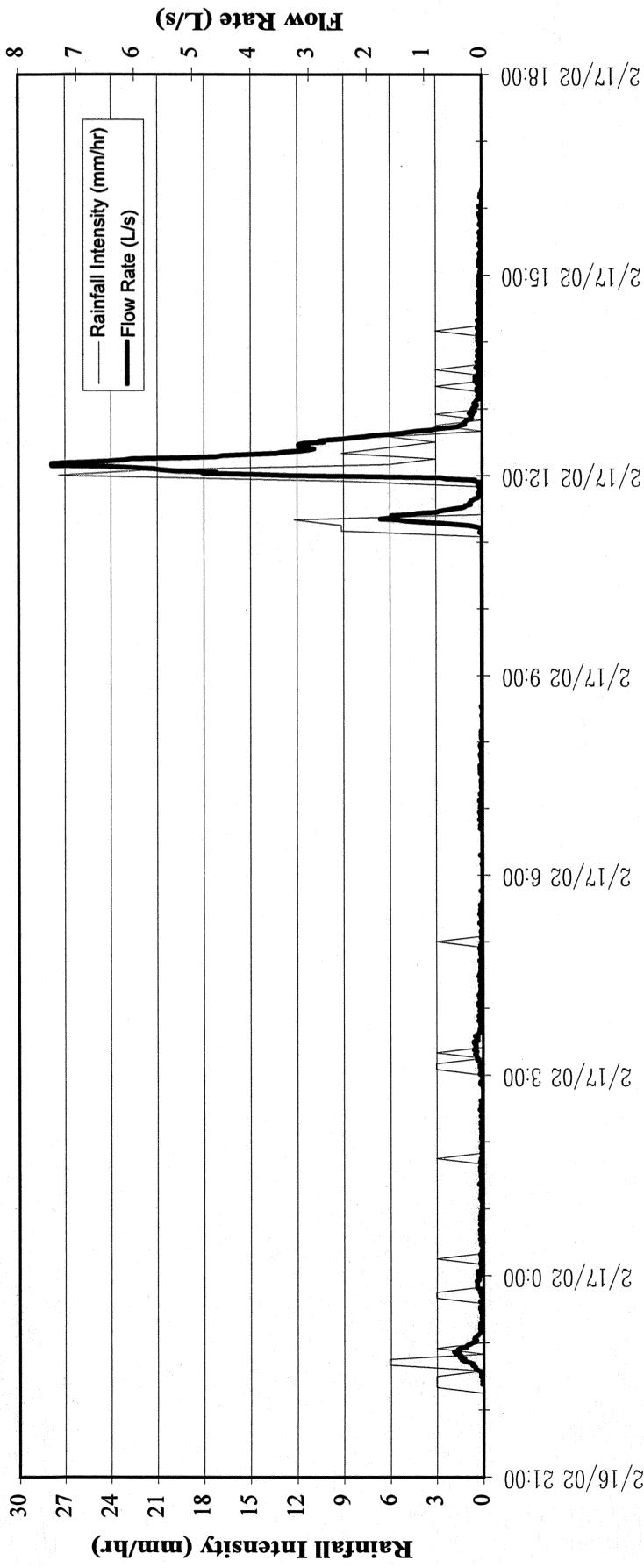
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

Notes:

Event Summary

Site: R41-PE6 (6-209)
Event: 2001-14

Catchment Area (ha): 0.13
Assumed Runoff Coefficient: 0.72



Rain Data

| | Rain Date | Runoff Data |
|------------------------|----------------|------------------------------|
| Start Date/Time: | 02/16/02 22:20 | Start Date/Time: |
| Stop Date/Time: | 02/17/02 14:10 | Stop Date/Time: |
| Event Rain (mm): | 15.24 | Total Flow Volume (L): |
| Max Intensity (mm/hr): | 27.43 | Peak Flow (L/s): |
| | | Observed Runoff Coefficient: |

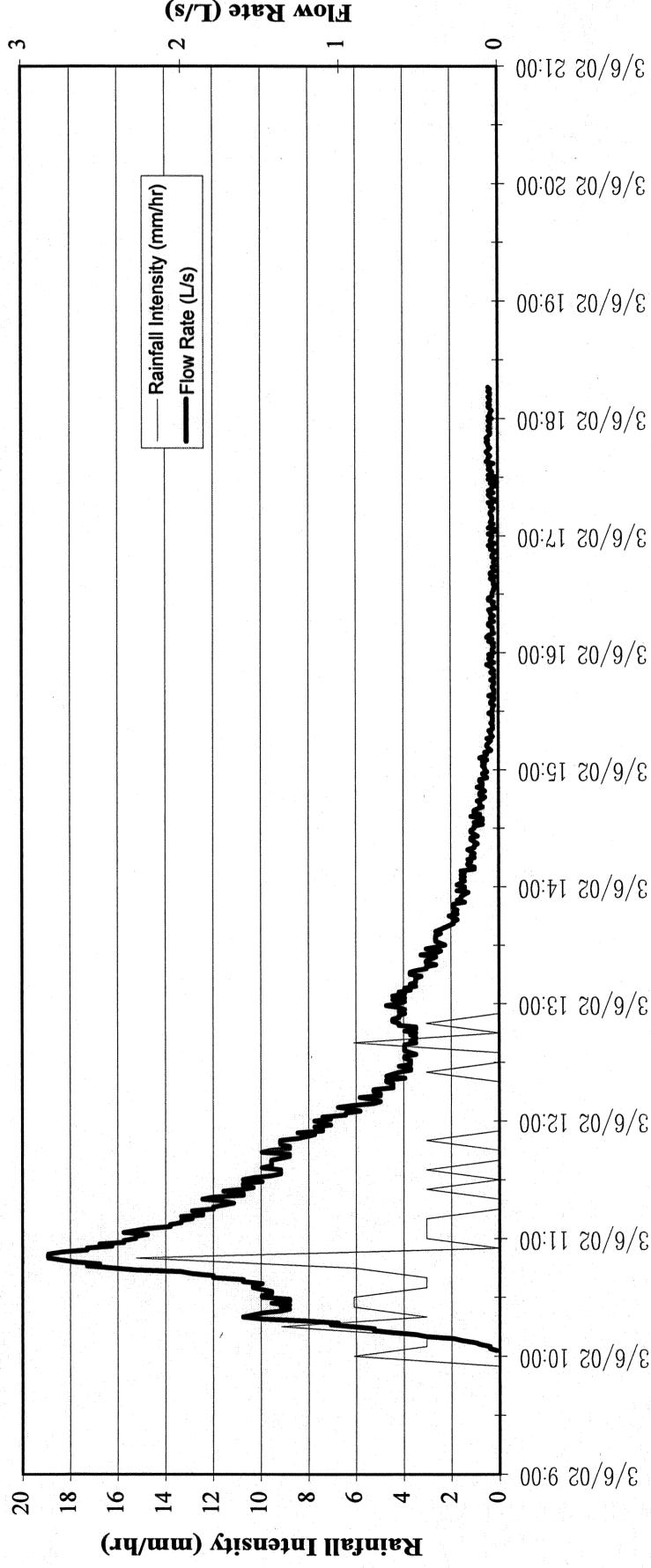
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

Notes:

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-15

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Rain Data

Start Date/Time: 03/06/02 10:00
Stop Date/Time: 03/06/02 12:50
Event Rain (mm): 7.62
Max Intensity (mm/hr): 15.24

Runoff Data

Start Date/Time: 03/06/02 10:03
Stop Date/Time: 03/06/02 18:17
Total Flow Volume (L): 16106
Peak Flow (L/s): 2.84
Observed Runoff Coefficient: 0.282

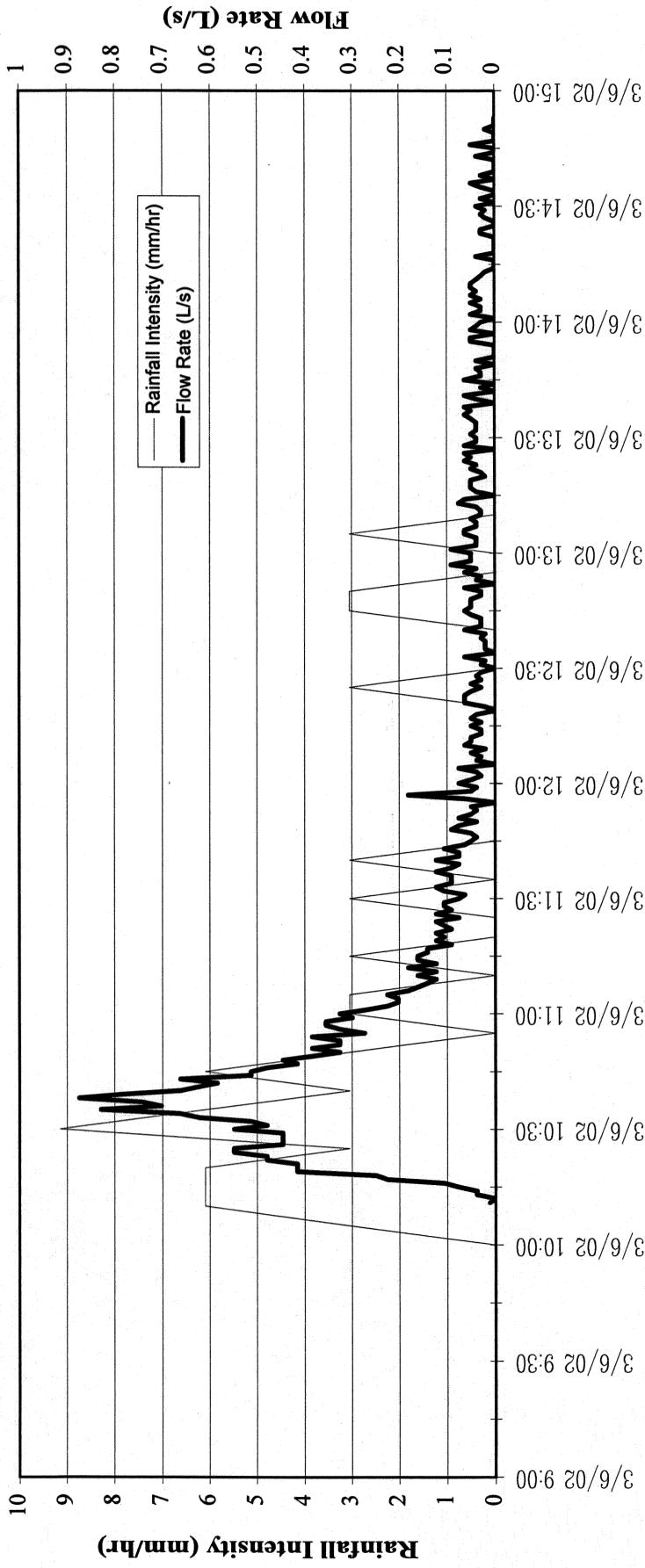
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

Notes:

Event Summary

Site: R41-PE6 (6-209)
Event: 2001-15

Catchment Area (ha): 0.13
Assumed Runoff Coefficient: 0.72



Rain Data

Start Date/Time: 03/06/02 10:05
Stop Date/Time: 03/06/02 13:05
Event Rain (mm): 6.35
Max Intensity (mm/hr): 9.14

Runoff Data

Start Date/Time: 03/06/02 10:11
Stop Date/Time: 03/06/02 14:54
Total Flow Volume (L): 2017
Peak Flow (L/s): 0.87
Observed Runoff Coefficient: 0.244

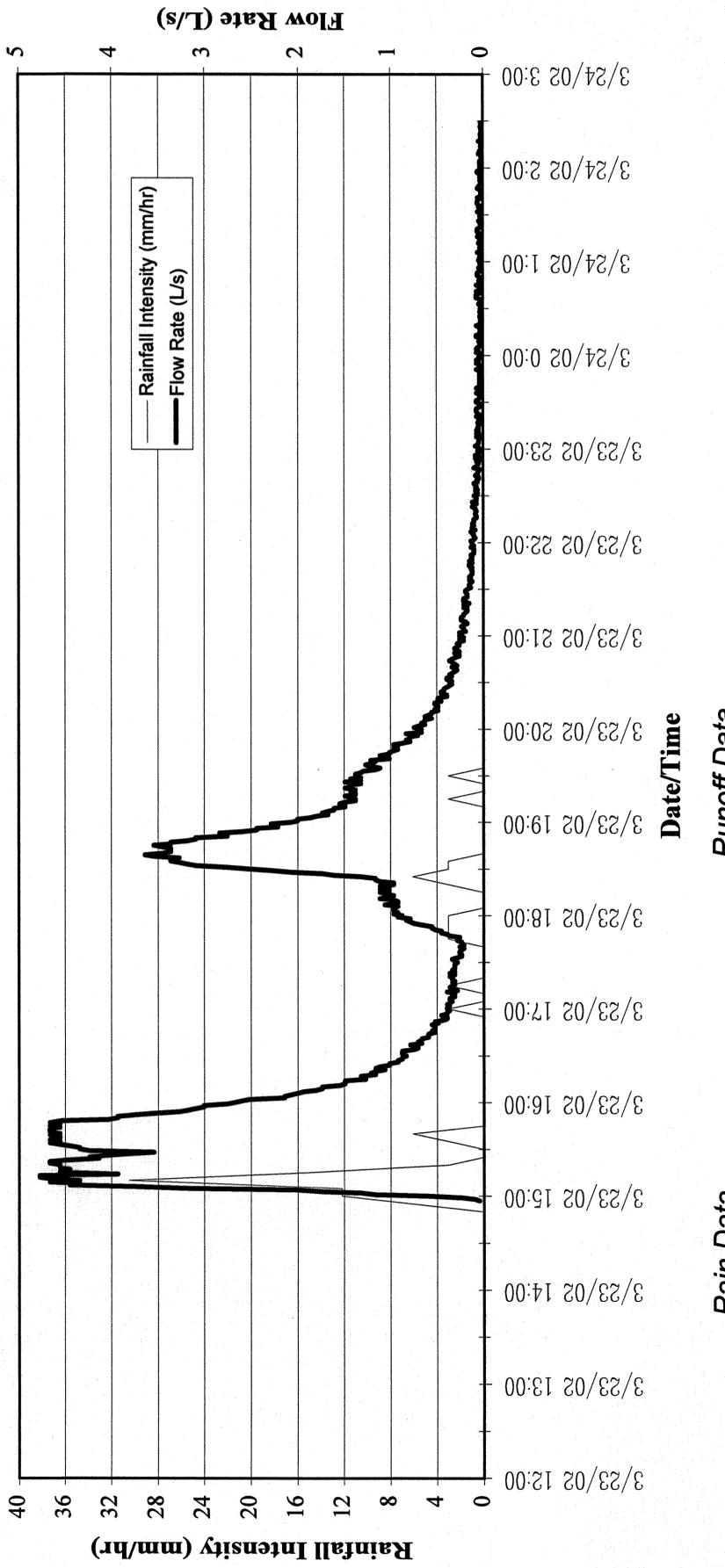
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Notes:

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-17

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Rain Data

| | | | |
|------------------------|----------------|------------------------|----------------|
| Start Date/Time: | 03/23/02 14:55 | Start Date/Time: | 03/23/02 14:57 |
| Stop Date/Time: | 03/23/02 19:30 | Stop Date/Time: | 03/24/02 02:30 |
| Event Rain (mm): | 10.41 | Total Flow Volume (L): | 34619 |
| Max Intensity (mm/hr): | 30.48 | Peak Flow (L/s): | 4.78 |

Runoff Data

| | |
|------------------------------|----------------|
| Observed Runoff Coefficient: | 0.443 |
| Start Date/Time: | 03/23/02 14:57 |
| Stop Date/Time: | 03/24/02 02:30 |
| Total Flow Volume (L): | 34619 |
| Peak Flow (L/s): | 4.78 |

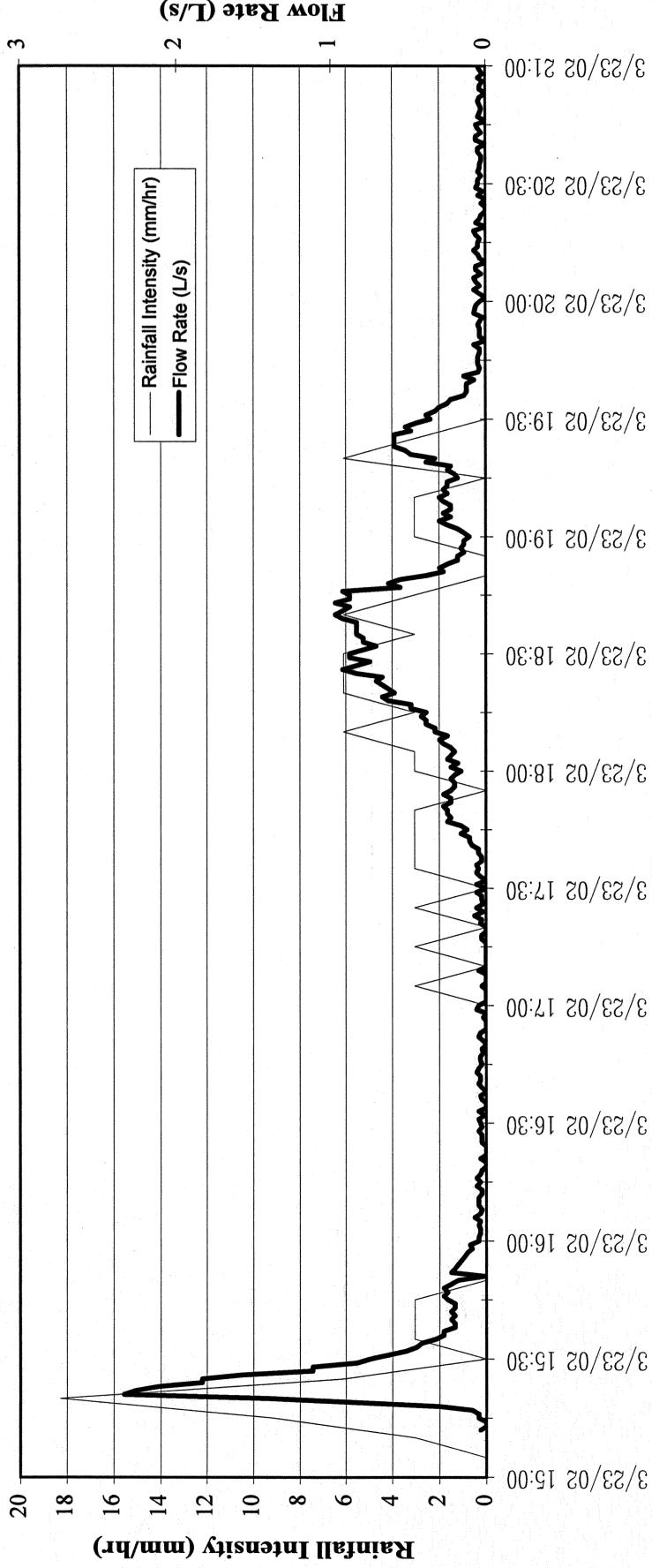
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Notes: Large runoff volumes as well as large amounts of vegetative matter within the litter bag, attached to the outflow pipe, created overflowing of the flume from 15:33 to 15:47. Normal flow was observed once the debris was removed.

Event Summary

Site: R41-PE6 (6-209)
Event: 2001-17

Catchment Area (ha): 0.13
Assumed Runoff Coefficient: 0.72



Rain Data

| | | | |
|------------------------|----------------|------------------------------|----------------|
| Start Date/Time: | 03/23/02 15:10 | Start Date/Time: | 03/23/02 15:12 |
| Stop Date/Time: | 03/23/02 19:25 | Stop Date/Time: | 03/23/02 21:27 |
| Event Rain (mm): | 10.67 | Total Flow Volume (L): | 4856 |
| Max Intensity (mm/hr): | 18.29 | Peak Flow (L/s): | 2.34 |
| | | Observed Runoff Coefficient: | 0.350 |

Runoff Data

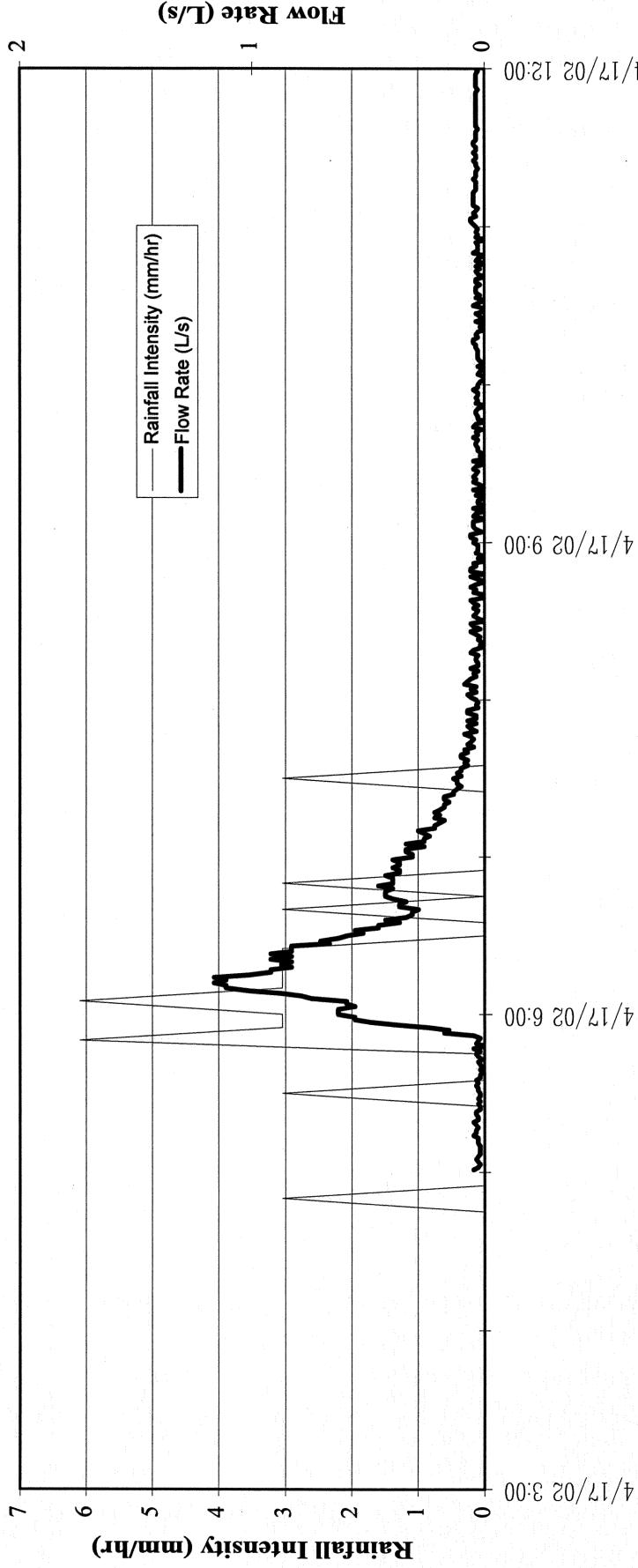
Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the latter collection event, refer to Section 2.

Notes:

Event Summary

Site: R180-PE2 (6-205)
Event: 2001-18

Catchment Area (ha): 0.75
Assumed Runoff Coefficient: 0.84



Date/Time

Runoff Data

| <u>Rain Data</u> | <u>Runoff Data</u> |
|------------------------------|---------------------------------|
| Start Date/Time: | 04/17/02 04:50 |
| Stop Date/Time: | 04/17/02 07:30 |
| Event Rain (mm): | 3.56 |
| Max Intensity (mm/hr): | 6.10 |
| | |
| | Start Date/Time: 04/17/02 05:01 |
| | Stop Date/Time: 04/18/02 08:33 |
| Total Flow Volume (L): | 5313 |
| Peak Flow (L/s): | 1.16 |
| Observed Runoff Coefficient: | 0.199 |

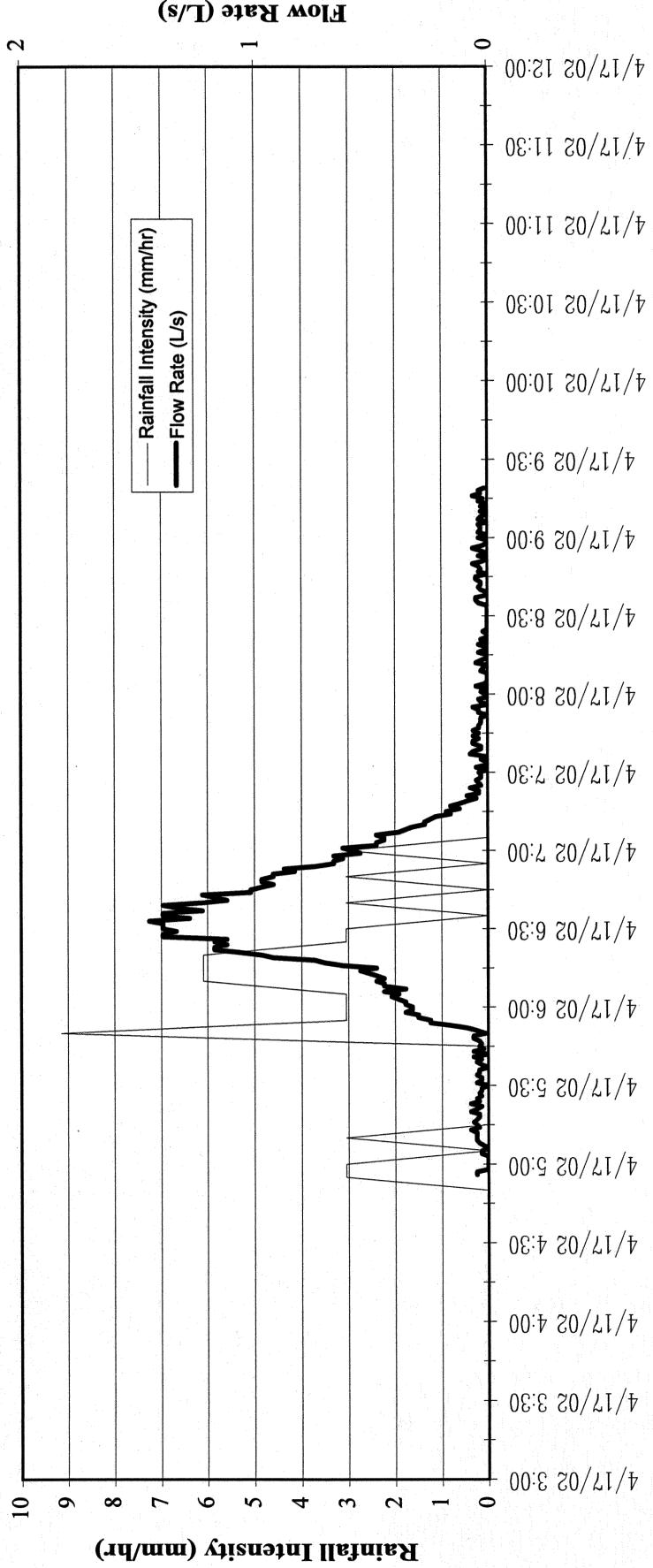
Notes:

Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Event Summary

Site: R41-PE6 (6-209)
Event: 2001-18

Catchment Area (ha): 0.13
Assumed Runoff Coefficient: 0.72



Rain Data

Start Date/Time: 04/17/02 04:55
Stop Date/Time: 04/17/02 07:00
Event Rain (mm): 4.83
Max Intensity (mm/hr): 9.14

Runoff Data

Start Date/Time: 04/17/02 04:56
Stop Date/Time: 04/17/02 09:20
Total Flow Volume (L): 4019
Peak Flow (L/s): 1.45
Observed Runoff Coefficient: 0.641

Rain and runoff totals are based on criteria established by the Caltrans data reporting protocols as calculated by Caltrans Hydrologic Utility (Version 1.8). For total rain and runoff associated with the litter collection event, refer to Section 2.

Notes:

APPENDIX C

APPENDIX C

Litter Sample Photographs